ADDENDUM NO. 4 TO THE WORK PLAN FOR VARIOUS SOURCE REMOVAL SITES AT NAVAL AIR WARFARE CENTER WARMINSTER, PENNSYLVANIA

Prepared For:

NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
LESTER, PENNSYLVANIA 19113

CONTRACT NO. N62472-94-D-0398
DELIVERY ORDER NO. 0018

June 1998

Prepared by:

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Revision	Date	Prepared By	Approved By	Pages Affected
2	September 28, 1998	J. Magee, P.E.	J. Gorgol, P.E.	All

ADDENDUM NO. 4 TO THE WORK PLAN FOR VARIOUS SOURCE REMOVAL SITES AT NAVAL AIR WARFARE CENTER WARMINSTER, PENNSYLVANIA

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Prepare in quintuplicate (original and 4 copies)

CONTRACTOR DRAWINGS & INFORMATION SUBMITTAL
NORTHNAVFACENGCOM 4335/3 (Rev. 6/80)

CONTROL NO. 2P

CONTRACT NO.	DELIVERY ORDER #	ACTIVITY LOCATION
N62472-94-D-0398	0018	Warminster, PA

PROJECT TITLE:
Various Remedial Action at NAWC

FROM:	DATE
Foster Wheeler Environmental Corp. - Program QCM: Mark Miller	September 29, 1998
TO:	DATE
S. Lehman (5 copies)	September 29, 1998

1. THE CONTRACTOR SUBMITTALS LISTED BELOW ARE FORWARDED FOR YOUR REVIEW AND RECOMMENDATIONS.
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   (b) RETAIN ONE (1) COPY OF THIS TRANSMITTAL FORM AND RETURN REMAINING COPIES WITH REVIEWED SUBMITTALS TO ROICC.
2. THESE SUBMITTALS SHOULD BE RETURNED TO THIS OFFICE BY _____
3. _____

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[X] ROICC **E. Beatty (2 copies)** [X] RPM **L. Monaco (1 copy)** [X] CSO **M. Hunter (1 copy)**

Mark Miller 9-29-98
SIGNATURE AND DATE

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1. THE SUBMITTALS LISTED BELOW HAVE BEEN REVIEWED AND ARE APPROVED/DISAPPROVED AS SHOWN BELOW AND ON EACH STAMP IMPRINT.

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FOR COMMANDING OFFICER, NORTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND — DATE

ITEM NO.	SUBMITTAL DESCRIPTION	PREPARED/ SUBMITTED BY	APPROVED	DISAPPROVED	REMARKS
2p	SD-18, Records;Addendum #4 to Work Plan –R2	M Miller			

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1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) has been contracted by the Northern Division, Naval Facilities Engineering Command to provide various remedial actions at the Naval Air Warfare Center located in Warminster, Pennsylvania (NAWC Warminster). This document is Addendum No. 4 to the Work Plan, dated June 21, 1996, and has been prepared to satisfy requirements of Remedial Action Contract Number N62472-94-D-0398, Delivery Order No. 0018 for Various Removal Actions. This Addendum specifically addresses installation of the groundwater extraction and transfer system at Area A and connection to the existing groundwater treatment system.

Sections of previous addenda have been intentionally omitted, as noted, to streamline this submittal.

2.0 SITE DESCRIPTION

2.1 PROJECT LOCATION AND DESCRIPTIONS

Eight sites on the NAWC Warminster property have been identified as locations used for disposal of wastes containing hazardous substances. These sites are shown in Figure 2-6. All sites are located within the facility boundaries and include the following:

- Three waste burn and disposal pits (Sites 1, 3 and 6);
- Two sludge disposal pit areas (Sites 2 and 7);
- Two landfills (Sites 4 and 5); and,
- One fire training area (Site 8).

Historically, wastes at the facility were generated during aircraft maintenance and repair, pest control, fire fighting training, machine and plating shop operations, spray painting, and various materials research and testing activities. Wastes from these processes included paints, solvents, waste oils, construction and demolition debris, office trash, general refuse and other forms of solid waste. Area A generally consists of Sites 1, 2 and 3.

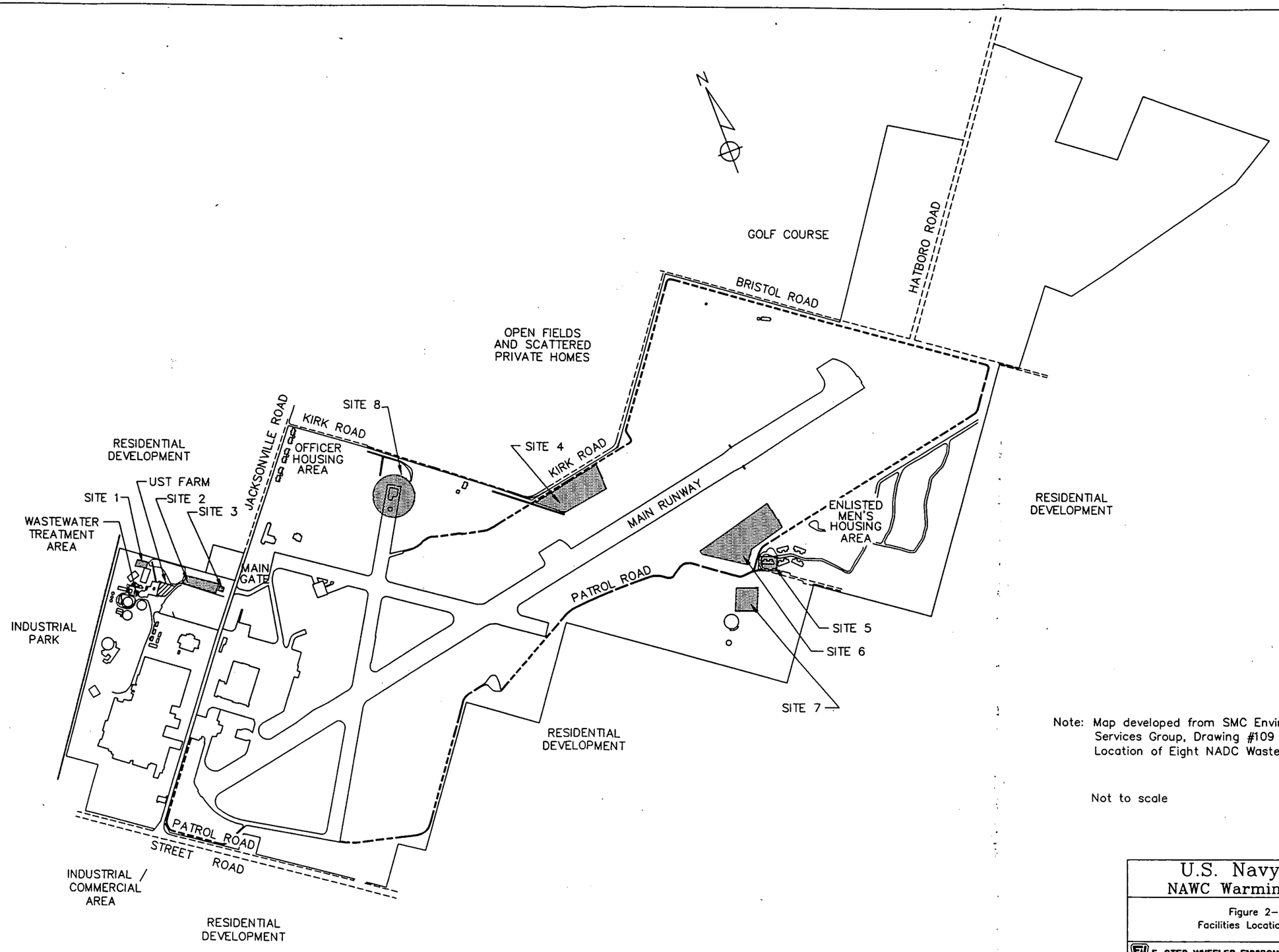
2.1.1 Site 4 (See original Work Plan)

2.1.2 Site 6 (See Work Plan Addendum No. 1)

2.1.3 UST Farm (See Work Plan Addendum No. 2)

2.1.4 Sites 1, 2 and 3 (from Work Plan Addendum No. 3)

Site 1 is located on a portion of the NAWC Warminster property lying northwest of Jacksonville Road and is adjacent to the base groundwater treatment plant. Site 1 was operated as a burn pit within an eroded ravine from approximately 1948 to 1950. Various wastes such as paints, oils, asphalt, roofing material, solvents, scrap metals, and unspecified chemicals were burned within this pit. The quantity of



Note: Map developed from SMC Environmental Services Group, Drawing #109 9328 880001, Location of Eight NADC Waste Sites, July 1990.

Not to scale

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U.S. Navy RAC
NAWC Warminster, PA

Figure 2-6
Facilities Location Map

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wastes deposited or burned is unknown. After use of Site 1 was discontinued, the area was covered with soil from an on-base source. Presently Site 1 is a maintained grassy area with base perimeter fencing on the northeast and northwest sides. The layout of Site 1 is shown on Figure 2-7.

Site 2 is located southeast of Site 1 along the perimeter fence. Site 2 extends southwesterly almost to the former UST farm. A 48-inch diameter storm drain pipe crosses Site 2 and discharges into an unnamed tributary of Little Neshaminy Creek just outside of the base perimeter fence. Site 2 consists of disposal trenches which received industrial wastewater sludges from on-site surface impoundments. Site 2 was covered with two feet of fill, regraded, and seeded. Presently, Site 2 is an open grassy area except for a stone road which provides secondary access to the groundwater treatment plant. The layout of Site 2 is also shown on Figure 2-7.

Site 3 is immediately southeast of Site 2 and also close to the northern base perimeter fence. Site 3 consisted of a pit that was reportedly used from 1955 to 1965 as a burn pit for solvents, paints, roofing materials, and other unspecified chemicals. Upon closure, Site 3 was reportedly backfilled with on-base soil and regraded.

2.1.5 Area A Groundwater Extraction and Transfer System

High concentrations of trichloroethene (TCE) have been detected in groundwater in the northwestern portion of Area A. Free-phase dense non-aqueous phase liquids (DNAPLs) may be present in this area. Area A is located hydraulically upgradient from Warminster Municipal Well No.26, which is a water supply well for the local township.

Area A generally consists of Sites 1, 2, and 3, and is located in the northwest corner of the fenced facility (Figure 2-6). Area A is located within a relatively flat-lying area, and is bordered to the north by industrial/commercial properties. An unnamed tributary of Little Neshaminy Creek is located along the northern edge of the area. The NAWC Warminster wastewater treatment facility, jet fuel storage area, and parking lots are located immediately to the south. Sites 1, 2, and 3 have been described in Section 2.1.4.

NAWC Warminster formerly operated eight unlined lagoons for storage of wastewater treatment plant sludge. These lagoons were located in the northern corner of Area A, in what is now an open grassy area. Each lagoon was approximately 60 feet wide, 75 feet long, and 8-10 feet deep. The lagoons were clean-closed in 1973, backfilled, and replaced with two concrete-lined surface impoundments. Sludge from the lagoons was reportedly disposed of in Site 7 (Area B).

A fuel farm is located immediately south of the former location of the unlined lagoons (Figure 2-7). This area includes a gas station with gasoline and diesel fuel USTs, four 15,000-gallon JP-5 USTs, and a storage building. No releases are known to have occurred in this area, however, localized PCE contamination has been detected in groundwater in the general vicinity of the fuel farm.

Surface water drainage from Area A is toward the northeast into the unnamed tributary of Little Neshaminy Creek. Groundwater flow across Area A is toward the north-northwest, with a horizontal gradient of approximately 0.02 feet/foot.

A groundwater extraction and treatment system exists and is currently in use to treat groundwater from Area C extraction wells. This system will also be used to treat groundwater from the Area A extraction wells.

AREA A EXTRACTION AND OBSERVATION WELL LOCATIONS

FOR EXTRACTION WELL AND OBSERVATION WELL DETAILS
SEE DRAWINGS C-10 AND C-11

TRANSFER STATION A
SEE DRAWINGS C-5 AND C-9
FOR DETAILS

TRUCK APRON
GRASS
GRAVEL ROADWAY
GATE
GROUNDWATER TREATMENT BUILDING
CARBON TRANSFER PAD
APRON
SLUDGE LAGOON
SLUDGE LAGOON
SIDEWALK
SAND FILTER
INV 12" RCP
IE 308.60
MH RIM=313.21
1W
INV=293.72 48"
FLOW
WEIR BOX
8' x 9.5'
TG=310.46
INV=294.92 IN
INV=294.89 OUT
2001 CB
2002 CB
2003 CB
2055 CB
2054 CB
2038 CB
2056 CB
259
93
86
310
312
314
316
318
308
306
304
302
300
298
296
294
SS
W
SD
ST

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LEGEND:

— —	TRANSFER LINE OR COLLECTOR DRAIN
F	FUEL
T	TELEPHONE
E	ELECTRICAL
SS	SANITARY SEWER
SD	STORM DRAIN
W	WATER LINE
	SITE BOUNDARY/FENCE

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PRESENTED ON ALL ARRANGEMENT DRAWING WAS COLLECTED BY BOUCHER & JAMES INC. IN DECEMBER 1993 AND MARCH 1994 FOR PURPOSES OF THIS INTERIM REMEDIAL ACTION. SITE FEATURES OUTSIDE THE SURVEYED AREA ARE PRESENTED FOR REFERENCE AND ORIENTATION.
2. SITE FEATURES OUTSIDE THE SURVEYED AREA, AND SELECTED UNDERGROUND UTILITIES INFORMATION WERE MANUALLY DIGITIZED FROM DRAWINGS PREPARED BY WEP ASSOCIATES, INC. OF WEST CALDWELL, NJ AS PROVIDED BY THE NAVAL AIR WARFARE CENTER. THIS INFORMATION IS SUBJECT TO FIELD CONFIRMATION AND HALLIBURTON NUS MAKES NO WARRANTIES WITH RESPECT TO ITS ACCURACY OR COMPLETENESS.

0 30
SCALE IN FEET

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NAWC Warminster, PA

Figure 2-7
Area A Basemap

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The existing groundwater extraction and treatment system includes the following:

- Area C groundwater extraction and transfer system
- Flow equalization, pH adjustment, chemical oxidation, and precipitation
- Flocculation and clarification
- Sand filtration
- pH neutralization and air stripping with off-gas treatment
- Liquid phase granular activated carbon adsorption
- Sludge thickening and dewatering
- Treated water discharge

The groundwater transfer pumps from Area C discharge to the equalization tank. The equalization tank also receives sand filter backwash water, filter press filtrate, sludge thickener/holding tank overflow, building sump water, and recirculation water from the equalization tank transfer pumps and the carbon adsorbers.

Hydrogen peroxide and caustic soda can be added to the equalization tank if metals treatment is necessary. The hydrogen peroxide can be added to oxidize the reduced forms of iron and manganese to lower the solubility of these metals. The caustic soda is added to increase the groundwater pH to approximately 9.0, further reducing solubility. This facilitates the removal of these metals as precipitates. At this time these chemical feeds have not been used due to the low levels of inorganics in the influent.

The equalized and chemically treated groundwater is pumped to a flash mix tank, where polymer can be added. The flash mix tank flows to a flocculation tank, where gentle agitation promotes the formation of large, faster settling particles. At this time polymer is not being added due to the low levels of inorganics in the influent. The groundwater flows from the flocculation tank to an inclined plate separator for settling of suspended solids. The inclined plate separator distributes flow evenly between the series of inclined plates, allowing clear water to rise gently to an overflow weir while precipitated solids and other suspended materials settle downward into a hopper at the base of the unit to form a sludge layer. The sludge can be transferred to a dewatering system consisting of a sludge thickening/holding tank and a filter press. The sludge dewatering system has not been used at the site to date.

The overflow from the inclined plate separator passes through a continuous backwash sand filter for additional particle removal. The filtrate drains by gravity to a continuously mixed neutralization tank, where acid can be added to lower the pH to about 7.0. The neutralized groundwater is delivered via gravity to a low profile air stripping system for removal of volatile organic compounds (VOCs). The final treatment step pumps the water from the air stripper sump through two granular activated carbon adsorbers operated in series. The units remove residual volatile and semi-volatile organic compounds (SVOCs) prior to discharge.

Air leaving the air stripper is heated to decrease the relative humidity below 50 percent, then passed through an emissions control system consisting of activated carbon columns to remove organics stripped from the groundwater. The sand filter is covered and vented through a filter emission control system consisting of activated carbon canisters. The remaining equipment is covered and vented passively through a tank ventilation emissions control system consisting of activated carbon canisters, with the exception of the thickener, the filter press and the supernatant filtrate recycle tank.

The treated groundwater is discharged via the existing facility outfall to an unnamed tributary of the Little Neshaminy Creek.

3.0 SCOPE OF WORK

3.1 GENERAL SCOPE

The general scope of work for Addendum No. 4 will be installation of a groundwater extraction and transfer system, in conjunction with the excavation and off-site disposal of contaminated soil hot spots within Sites 1, 2, and 3 (in Area A) described in Addendum No. 3. Foster Wheeler Environmental will provide supervision, labor, equipment and materials required to perform these activities, in accordance with applicable regulations. Foster Wheeler Environmental will also provide construction quality control and health and safety personnel. The site tasks will include the following: mobilization and site preparation; installation/testing of nine groundwater extraction wells and three observation wells, including associated piping/pumps to transfer extracted groundwater to the on-site treatment system.

The design documents which will be utilized by Foster Wheeler Environmental in the construction of the Area A groundwater extraction and transfer system include, but are not limited to the following:

- Drawings (developed by Haliburton NUS Corporation):

E-1	Electrical Legend
E-2	Single Line Diagram Sheet 1
E-4 - E-11	AC Schematic Diagram Area "A" Sheets 1-8
E-14 - E-16	Instrumentation Schematic Diagram Sheets 1-3
E-18 - E-31	Cable and Conduit Schedule Sheets 1 - 14
E-32	Interconnection Diagram Sheet 1
E-33	Interconnection Diagram Sheet 2
E-36	Interconnection Diagram Sheet 5
E-40	Motor Control Center Layout
E-47	Wellfield Conduit Plans
E-48	Area "A" Wellfield Sections
C-1	Symbols and Abbreviations
C-3	Area "A" Groundwater Transfer Line - Hydraulic Profile
C-5	Area "A" Groundwater Transfer Station - Hydraulic Profile
C-7	Area "A" Groundwater Extraction and Monitoring Well Arrangement
C-9	Areas "A" and "B" Transfer Station and Access Sump Details
C-10	Groundwater Extraction Wells Details
C-11	Groundwater Observation Wells Details
C-12	Erosion Control Plan and Details
C-13	Site Grading Plan and Sections
C-14	Land Management Plan - Soils
C-15	Land Management Plan - Surface Drainage
P-1	Piping and Instrumentation Symbols
P-2	Process Flow Diagram
P-3	Piping and Instrumentation Flow Diagram - Groundwater Extraction
P-4	Piping and Instrumentation Flow Diagram - Equalization
P-10	Groundwater Treatment System - Process Equipment List
P-11	Groundwater Treatment System - Process Piping Arrangement
P-12	Groundwater Treatment System - Process Piping Arrangement Sections
P-14	Utility Piping Arrangement Plan
P-15	Utility Piping Arrangement Sections
P-16	Treatment Building Piping Sections

P-17 Groundwater Treatment System - Utility Connection Drawing

- Specifications (developed by Haliburton NUS Corporation): Pump and Treat System for Interim Remedial Action at the Naval Air Warfare Center Warminster, Pennsylvania, July 8, 1994 (Specification No. 04-93-0397).

- Plans

  1. Extraction Well and Observation Well Drilling Procedure for Area A at NAWC Warminster, Pennsylvania (October, 1997).

  2. Yield Testing Procedure for Pump and Treatment System for Interim Remedial Action NAWC, Warminster, Pennsylvania (December 1, 1994).

3.2 SITE 4 (See original Work Plan)

3.3 SITE 6 (See Work Plan Addendum No. 1)

3.4 UST FARM (See Work Plan Addendum No. 2)

3.5 SITES 1, 2 AND 3 (From Work Plan Addendum No. 3)

Because these activities will occur in conjunction with the Area A extraction well installation, certain sections are repeated here.

Remediation will include the following activities:

- Utility investigation and markout.
- Pre-Mobilization surveying and sampling, via drilling, of the targeted hot spots to be remediated.
- Mobilizing equipment and facilities to the site and preparing the area for remediation, including installing erosion and sediment pollution controls, decontamination pad and support facilities. In addition, preparing for perimeter air monitoring.
- Providing protection for existing monitoring wells, control panels, transfer sump and any other known utilities or structures.
- Removal/replacement of existing stone road as needed.
- Excavating and backfilling the hot spot areas including the following: excavating and disposing of solid wastes and debris, backfilling and compacting the excavations and decontaminating all equipment before leaving site.
- Restoring the site with topsoil and seeding.
- Demobilizing all equipment, personnel and supplies at the completion of the project.

Health and safety requirements for project activities are found in Addendum No. 4 to the Site-Specific Health and Safety Plan.

3.5.1 Pre-Mobilization Surveying and Soil Sampling (See Addendum No. 3)

3.5.2 Mobilization and Site Preparation

Mobilization and site preparation will consist of mobilization of the following items and services to the site: equipment, support trailers, utility hook-up, and preparation of the site for initiation of excavation activities. Activities performed prior to starting remediation will include the following: coordination of labor resources; procurement of surveying, drilling, laboratory and transportation and disposal services; and, the procurement of materials, equipment and supplies related to the remediation effort. Craft labor will be hired, as needed, from the local union halls and will receive site orientation on the first work day.

The specific requirements for site preparation for the NAWC Warminster Area A sites are provided in the following sections.

Temporary Construction Facilities and Utilities

Remobilization and temporary utility hookup of an office trailer will be required in Area A. A proposed location for the office trailer is shown on Figure 3-12 (Remedial Layout). The final location will be coordinated with the ROICC and CSO. All electrical and set-up activities will follow guidelines outlined in the original Work Plan.

Heavy equipment and materials will be rented or purchased on an as-needed basis.

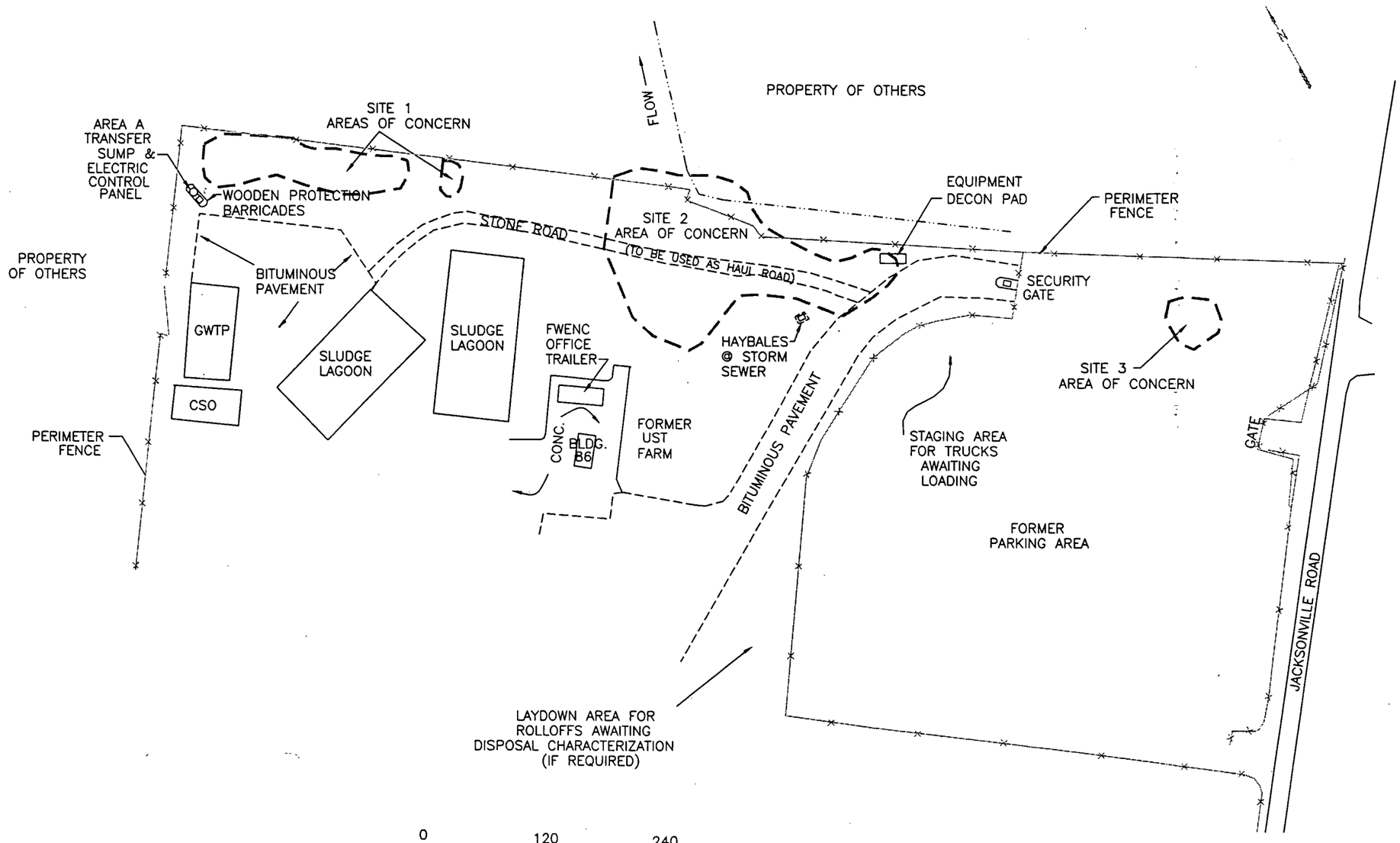
Erosion and Dust Control

Prior to the construction activities, erosion and sediment pollution control measures will be implemented as illustrated in Figure 3-12. These controls will include the following:

- Installation of silt fence along the down gradient side of each area of excavation, along the perimeter fence and any other areas where surface water run off may be a concern.
- Dust control measures via water spraying of exposed soil areas.
- Provisions will be made to prevent construction vehicles from tracking excess dirt and mud off-site.
- Earthen berms for diversion of surface runoff on an as-needed basis.
- Hay bales staked around nearby storm water inlets.

Foster Wheeler Environmental will have a pick-up truck with a water tank and a gravity fed sprinkler system drive through the accessible areas of the site to control dust. A pump and hose will also be available on the truck to wet down areas out of reach of the sprinkler system.

Foster Wheeler Environmental will maintain these controls for the duration of the project. A more detailed plan for erosion and surface water control is provided in Section 7.2 of this Addendum.



NOTES:

- THE LIMITS OF EXCAVATION ARE TO BE DETERMINED BY THE NAVY. SPECIFIC LOCATIONS FOR SILT FENCE WILL BE PROVIDED AT THAT TIME.
- WOODEN PROTECTION BARRICADES WILL ALSO BE PROVIDED AROUND MONITORING WELLS.

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U.S. Navy RAC
NAWC Warminster

Figure 3-12

Remedial Layout

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Construction Entrance/Haul Road

Access to Sites 1 and 2 will be through the main gate located southeast of Site 2. Construction traffic will then proceed on the facility road until it intersects with an existing stone road. This stone road will be utilized as the primary haul road to and from Sites 1 and 2. Minor extensions to the road may be required depending upon the finalized limits of excavation. Since Site 3 is located in the parking lot area, a haul road is not required.

Site maps will be provided to the transportation subcontractor to direct traffic from Jacksonville Road to Sites 1 and 2.

Decontamination Pad

A temporary decontamination pad will be built to contain wastewater and contamination removed from all equipment prior to leaving the remediation area and/or demobilization. The proposed location of the decon pad is shown on Figure 3-12. Trailers hauling contaminated soils will remain in cordoned off "clean zone" during loading of contaminated soil. The area will be lined with a heavy mil plastic sheeting with sandbags around the perimeter. Prior to leaving the site, the sheeting will be swept clean of any spilled debris, thus preventing the tracking and spreading of contaminated material and therefore, the trailers shall not require decontamination prior to leaving the site. The "clean zone" however, will be subject to confirmatory sampling at the end of the remedial action.

Soil Staging Areas

All excavated soil, which was not sampled during the pre-mobilization sampling event, will be placed directly into roll-off containers while awaiting characterization sampling and analysis. This will apply only to soil removed from areas outside the original limits of excavation. The exact location of a staging area will be determined during field operations and pre-approved by the CSO. Roll-offs will be provided with waterproof tarps.

Perimeter Air Monitoring

Assessment and evaluation of site perimeter exposures to total suspended particulates and any metals of concern will be accomplished through the use of integrated air monitoring stations. Specifics on the air monitoring procedures can be found in the Health and Safety Plan, Addendum No. 4.

3.5.3 Excavation and Backfilling (See Addendum No. 3)

3.5.4 Restoration

Restoration of Site 1, 2, and 3 will include placement of certified topsoil, final grading and seeding. After backfilling and compacting the excavations, the operators will grade and level the area with equipment that has been previously decontaminated. Final grading of the six inches of topsoil will blend in with existing contours on the site. After completing the final grading, all areas where vegetation was disturbed during the remedial action will be seeded with a commercially available lawn seed mix.

3.5.5 Demobilization

All excavation equipment used during Area A activities will be demobilized unless required for additional pending work. Support zone equipment, personnel and facilities will remain until notice is given by the Navy to demobilize.

3.6 AREA A GROUNDWATER EXTRACTION AND TRANSFER SYSTEM

Installation and testing of the groundwater extraction wells at Area A will involve the following activities:

- Mobilization of Foster Wheeler Environmental and drilling subcontractor personnel and equipment
- Installation, monitoring and testing of groundwater extraction and observation wells
- Concurrent monitoring of groundwater conditions from nearby monitoring wells
- Yield testing of groundwater extraction wells
- Installation of ancillary piping/controls to existing groundwater treatment system
- Site restoration, and
- Demobilization

3.6.1 Mobilization and Site Preparation

The following sections discuss the mobilization and site preparation work planned.

Construction Facilities and Equipment

Foster Wheeler Environmental will be mobilizing to Sites 1, 2 and 3 for the soil removal action, prior to the initiation of the Area A groundwater extraction and transfer system work. The mobilization will have included support trailers and necessary utility hook-ups, which should be sufficient to support the groundwater extraction and transfer system work.

Equipment Procurement

The procurement of the groundwater collection and transfer system equipment will be performed by Foster Wheeler Environmental. The solicitation of prices for the individual system components will be an ongoing activity during the construction. Equipment deliveries will not be scheduled until there is adequate storage space at the site, or the equipment is ready for installation.

Erosion, Sediment and Dust Control

Prior to the initiation of drilling or construction activities, erosion and sediment pollution control measures will be implemented. Controls will have been installed as part of the Site(s) 1, 2 and 3 remediation, however, these structures will be inspected and repaired as necessary. Controls will generally include the following:

- Installation of silt fence along the downgradient side of each excavation area, along the perimeter fence and any other areas where surface water may be a concern, as determined by the Project Superintendent.
- Installation of hay bales staked around nearby storm water inlets.
- Earthen berms for diversion of surface water runoff on an as-needed basis.
- Provisions to prevent construction vehicles from tracking excess soil and mud off-site.
- Dust control measures via water spraying of exposed soil areas.

Foster Wheeler Environmental will have a pick-up truck with a water tank and an gravity fed sprinkler system drive through the accessible areas of the site to control dust. A pump and hose will also be available on the truck to wet down areas out of reach of the sprinkler system.

Foster Wheeler Environmental will maintain these controls for the duration of the project. A more

detailed plan for erosion and sediment control is provided in Section 7.2 of this Addendum.

Decontamination Pad

The temporary decontamination pad built during the Site(s) 1, 2 and 3 remediation will remain on-site to contain wastewater and contamination removed from all equipment prior to leaving the construction area and/or demobilization. The location of the pad is shown on Figure 3-12A.

Site Survey

A professional land surveyor will be subcontracted by Foster Wheeler Environmental to locate the new extraction wells and observation wells in Area A, prior to well installation. Site datum and control points established during the site investigation and Site(s) 1, 2 and 3 will be utilized, as a basis for this surveying work. A representative from Brown and Root Environmental and the Technical Evaluation Group (TEG) Committee will be requested to verify the locations of all wells prior to drilling activities.

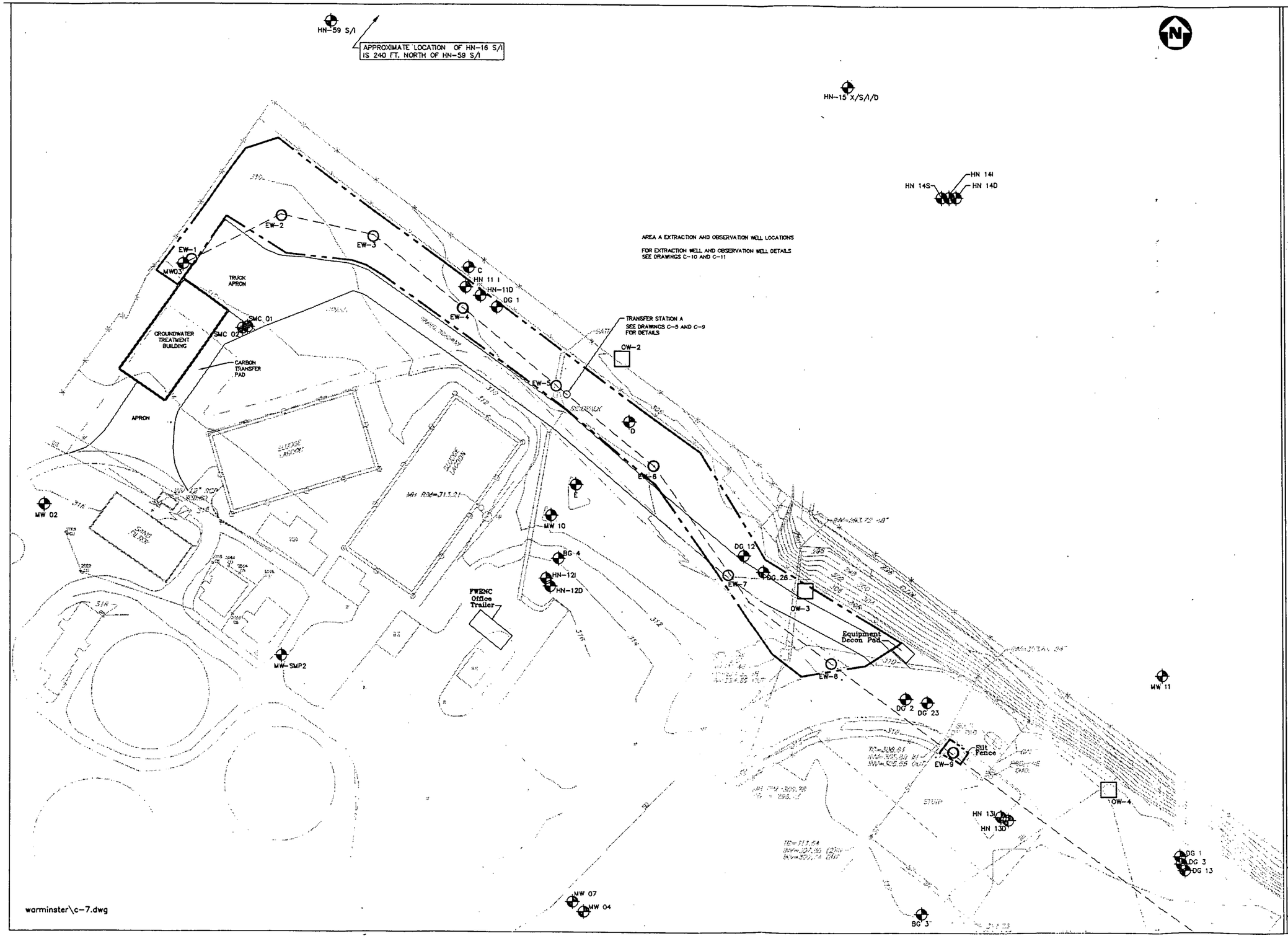
The survey will also include the route of the groundwater transfer piping from the water treatment building to the Area A groundwater collection system. This route survey will include the locations and elevations of the access sumps and transfer stations.

By using the surveying information, and the design specifications and drawings, the piping route will be established and tied into the grid coordinates referenced in the plans. The piping routes will be scaled from the project plans for initial layout. The route will be staked out using wooden stakes, and orange marking paint where necessary. Upon the initial layout and location of the piping route, access sumps, and transfer stations, control points based on existing benchmarks will be established along the piping route. As-built drawings will then be developed based on the data collected from the survey to properly record these locations, and these will be submitted to the Navy with the Final Report.

A Navy representative and Dig Safe will be contacted, and requested to provide the location for any utilities in and around the site before drilling and trenching activities begin.

Clearing and Grubbing

Site clearing and grubbing will be performed upon approval of the piping routing by the Navy. Foster Wheeler Environmental does not anticipate that a large amount of clearing and grubbing will need to be performed, however, if necessary activities will include the removal of any trees, bushes and shrubs encountered along the piping route. Clearing and grubbing equipment needs will be assessed and determined by the Project Superintendent upon approval of the piping route.



LEGEND:

- EXISTING MONITORING WELL
- PROPOSED EXTRACTION WELL
- PROPOSED OBSERVATION WELL
- TRANSFER LINE OR COLLECTOR DRAIN
- F FUEL
- T TELEPHONE
- E ELECTRICAL
- SS SANITARY SEWER
- SD STORM DRAIN
- W WATER LINE
- SILT FENCE
- SITE BOUNDARY/FENCE

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PRESENTED ON ALL ARRANGEMENT DRAWING WAS COLLECTED BY BOUCHER & JAMES INC. IN DECEMBER 1993 AND MARCH 1994 FOR PURPOSES OF THIS INTERIM REMEDIAL ACTION. SITE FEATURES OUTSIDE THE SURVEYED AREA ARE PRESENTED FOR REFERENCE AND ORIENTATION.
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SCALE IN FEET

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Figure 3-12A

Area A Basemap with Proposed Well Locations

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Investigation of Existing Area A Equipment

During the initial phases of the work, Foster Wheeler Environmental engineers will perform an investigation of the existing Area A equipment previously installed on-site to determine the condition of the equipment, and identify the exact type, quantity and locations of tie-in points. Any equipment or materials determine to be in unsatisfactory condition will be presented to the Navy at this time. The investigation will be performed by the Project Engineer, along with assistance from the Senior Project Engineer/Manager and an electrical/control system engineer.

This investigation will also allow Foster Wheeler Environmental to determine which of the existing materials currently on-site from the Area C collection and transfer system installation can be utilized in the construction of the Area A collection and transfer system.

3.6.2 Installation of Area A Groundwater Extraction System

The following sections describe the planned activities for the installation of the groundwater extraction and transport system.

3.6.2.1 Overview

A total of up to nine (9) groundwater extraction wells (EWs) and three (3) observation wells (OWs) are scheduled to be drilled and installed along the northern periphery of Area A (Figure 3-12A). The actual number of EWs and OWs may vary depending on groundwater quality conditions and results from yield tests conducted as each extraction well is installed.

Drilling will be initiated near the center of Area A, at the proposed location of EW-4; located immediately south of and adjacent to monitoring wells HN-11I/D. Proposed observation well, OW-2, will be installed prior to yield testing at EW-4. Subsequent EWs will be located on either side of EW-4, with the spacing/distance pending yield test results. OW-3 and OW-4 will be installed, if required, prior to yield testing of any EWs placed within 250 feet of their proposed locations.

Decisions regarding the need for observation wells OW-3 and OW-4 will also take into consideration the need for these wells for long-term performance monitoring, and will be a TEG/BCT decision. TEG members include representatives from the Navy, the USEPA, the USGS, and Brown & Root Environmental (BRE). The BCT (BRAC Clean Up Team) consists of representatives from the Navy, the USEPA, and the PA Department of Environmental Protection (PADEP). The TEG will decide upon the need for a yield test at each EW based on a review of lithologic logs, field screening results, field analytical results, and drilling yield estimates. This information will be faxed to the TEG within 24 hours after drilling at each EW is completed. A TEG conference call will be scheduled for the day after this information is faxed, and the TEG will decide on the need for a yield test and/or the location of the next EW. Yield tests will consist of short-term (6-8 hour duration) pumping tests at the newly installed extraction well(s). The pumping rate will be sufficient to induce significant drawdown in the pumping well and nearby observation wells, and enable long-term sustainable yields and capture zone projections to be estimated.

Air-hammer drilling techniques will be used to install Area A wells. Each extraction well will be drilled to approximately 80 feet bgs; actual footage will be dependent on encountering the target mudstone which acts as an apparent confining layer in the area of interest. Figure 3-2 of the 1995 Focused RI for Groundwater Report (NUS, 1995) indicates the target mudstone lies between 75 to 95 feet below ground surface (bgs) at monitoring well cluster HN-11I/D. Each borehole will be advanced no further than five feet into the target mudstone, which will be identified from drill cuttings and lithologic correlations from existing nearby wells. Wells located to the southeast of HN-11I/D will likely encounter the mudstone at

shallower depths (bedrock dip is approximately 7° to the northwest).

Ten-inch diameter black steel surface casing will be installed at least 10 feet into competent bedrock (bedrock is approximately 15 feet bgs). Six-inch diameter stainless steel wound-wire screen and riser will be installed to total depth. Air, water, and cuttings from each well will be monitored continuously via flame ionization detector (FID). The presence of DNAPLs on drill cuttings will be evaluated by visual observation; scanning with an ultraviolet (UV) lamp; hydrophobic dye testing; and field screening via portable gas chromatograph (GC). Groundwater samples will be obtained from isolated fractures within the borehole using inflatable packer assemblies. Any groundwater produced during drilling operations will be pumped to a holding tank and treated in the existing groundwater treatment system.

If the presence of DNAPLs is confirmed in a well, or bailed groundwater contains PCE in excess of 3.0 ppm or TCE greater than 23 ppm, DNAPL recovery efforts will be initiated using a bottom-loading pneumatic pump. Drilling, halted due to possible presence of DNAPLs, will be resumed following TEG authorization. No wells will be drilled within 200 feet of a well that is actively being pumped for DNAPL recovery.

Existing wells located within 200 feet of the well being drilled will be monitored daily for the presence of DNAPLs. Water levels in each of these nearby wells will be monitored prior to the start of drilling, at 2-hour intervals during drilling, and once after drilling is completed.

Six to eight downgradient monitoring wells will be sampled throughout the duration of Area A drilling.

Each EW and OW will be developed via air lift or submersible pump, at a drawdown of less than one-third the total available drawdown. All downhole tools/equipment will be decontaminated between each well location, following procedures established in the original Work Plan.

If requested by the TEG and approved by the Navy, temporary pump and treat equipment will be installed and operated by Foster Wheeler Environmental in completed extraction wells and/or existing monitoring wells in the vicinity of Area A. All treated discharge from any such system will adhere to criteria established with the August 28, 1997 PADEP temporary discharge permit, established in yield testing (including sediment and erosion control).

The sections below provide details for each of the activities.

3.6.2.2 Drilling Methodology

Air-hammer drilling techniques will be used to install Area A extraction and observation wells. Conventional air-hammer drilling specifications will be as outlined in the original Work Plan, with modifications detailed in this addendum. Advancement of each extraction well boring will be halted upon reaching the target confining mudstone (encountered in HN-11I/D at approximately 75-95 feet bgs, as shown in 3-2 of the 1995 Focused RI for Groundwater Report: NUS, 1995). The target mudstone will be identified via drill cuttings and correlations with existing nearby wells, with drilling halted no more than five feet into the top of the 20-25 foot thick confining unit. Drilling will be accomplished utilizing a 14-inch diameter bit to a depth of ten (10) feet into competent bedrock (bedrock lies approximately 15 feet bgs). After surface casing has been grouted in place, drilling will proceed to total depth using a 10-inch diameter bit.

The drilling subcontractor will use vegetable oil-based lubricants on drill pipe joints. The drilling subcontractor will containerize all drill cuttings in a specified roll-off dumpster located at Area A. Drill cuttings (and fluids) will be directed away from the borehole into a cyclone separator, which will slow the air velocity and allow cuttings to fall into a collection bin. The Foster Wheeler Environmental Project

Hydrogeologist and Health and Safety Officer will monitor cuttings continuously for lithologic variation, and presence of VOCs and/or DNAPL. Any groundwater produced during drilling operations will be collected and treated prior to discharge. The water will be pumped into a holding tank, stored and later treated in the existing groundwater treatment system.

3.6.2.3 Well Construction

Each Area A well will be drilled to the top of the mudstone encountered in HN-11I/D at approximately 75-95 feet bgs (as shown in 3-2 of the 1995 Focused RI for Groundwater Report: NUS, 1995). The target mudstone will be identified via drill cuttings and nearby well correlations, with drilling halted no more than five feet into the top of the 20-25 foot thick confining unit (unless directed otherwise by the Foster Wheeler Environmental and BRE hydrogeologists). Figures 3-13 and 3-14 illustrate the well construction details for the Area A extraction and observation wells.

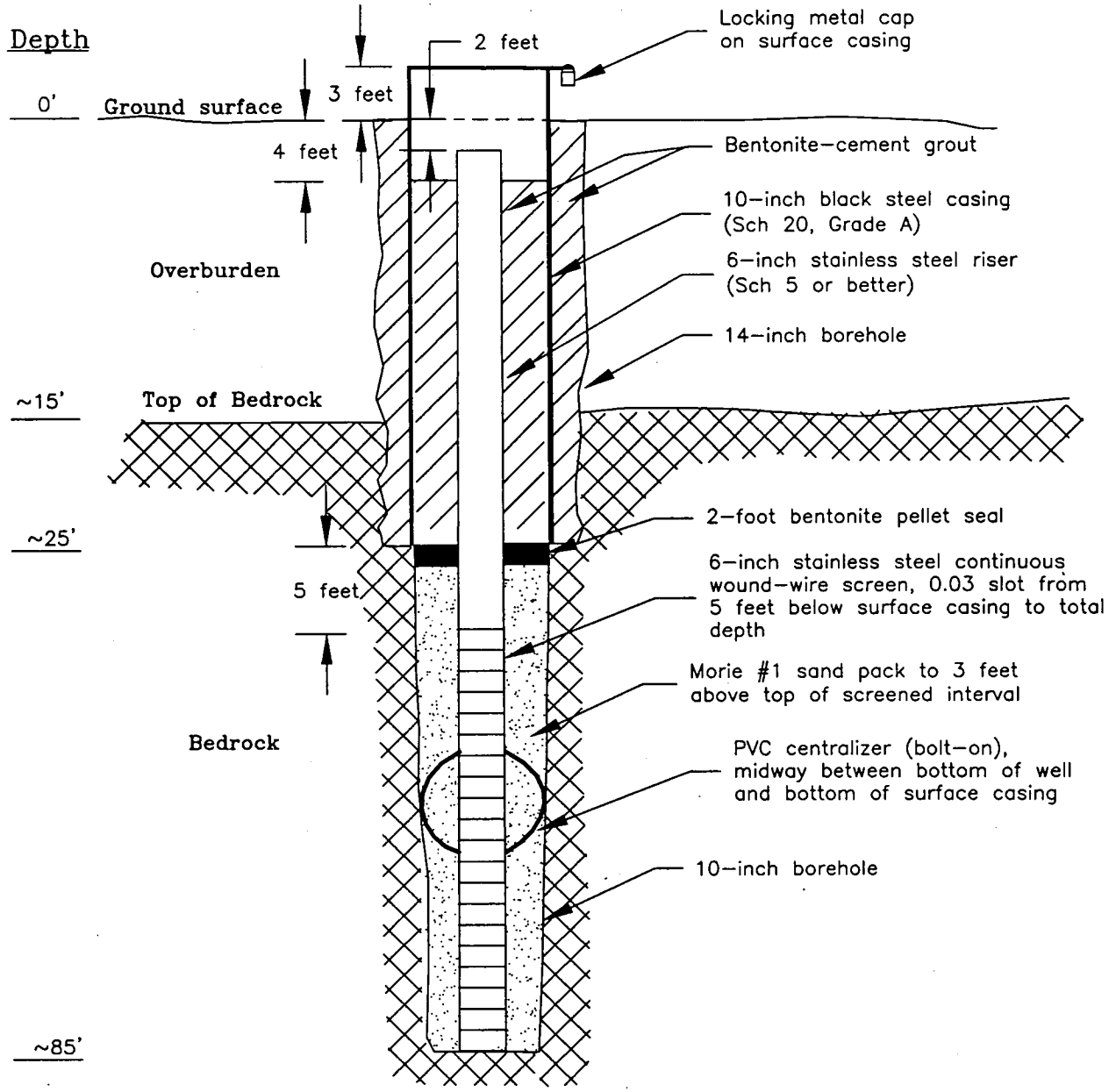
Extraction Wells

Extraction wells (EWs) will be drilled with a 14-inch diameter air-hammer to a depth of approximately ten (10) feet into competent bedrock (top of bedrock is approximately 15 feet bgs). Ten-inch diameter Schedule 20, Grade A black steel pipe will be installed within the 14-inch borehole. The annulus between the surface casing and the borehole will be tremie grouted from the bottom of the borehole to ground surface. Grout will consist of Type I Portland cement, with three pounds of granular bentonite per 94-pound bag of cement, mixed with 6.5 gallons of water. The surface casing will extend approximately three feet above grade, and will be fitted with a locking metal cap. Vaults will subsequently be installed at each EW, in conjunction with transfer piping to the on-site treatment system (Section 3.6.3).

After installation of the surface casing, open hole drilling may proceed for the first 4 hours after the surface grout has been applied, or after the grout has had a minimum of 24 hours to cure. Extraction wells will be drilled below the surface casing with a 10-inch air hammer.

Upon reaching total depth, extraction well boreholes will be developed until discharge water is visibly free of fines, or for a maximum of two hours/well. Well development will be accomplished via submersible pump or air lift. If air lift development is performed, an inductor pipe will be used with an inner air line, so that no air will come in contact with the borehole walls. Development yield will be controlled to ensure drawdown does not exceed one-third of the available drawdown. Extracted groundwater will be collected into an on-site holding tank. The holding tank will allow suspended solids to settle out and be disposed of, along with drill cuttings. Development fluids will be pumped to a holding tank, stored and treated in the existing groundwater treatment system. The Project Hydrogeologist will record development methods, duration, fluid characteristics, and flow rates in the site logbook.

Yield tests, described below in Section 3.6.2.8, will be conducted in open EW boreholes, prior to well completion.



Not to Scale

U. S. Navy RAC
NAWC Warminster, PA

Figure 3–13

Area A
Extraction Well Construction Diagram

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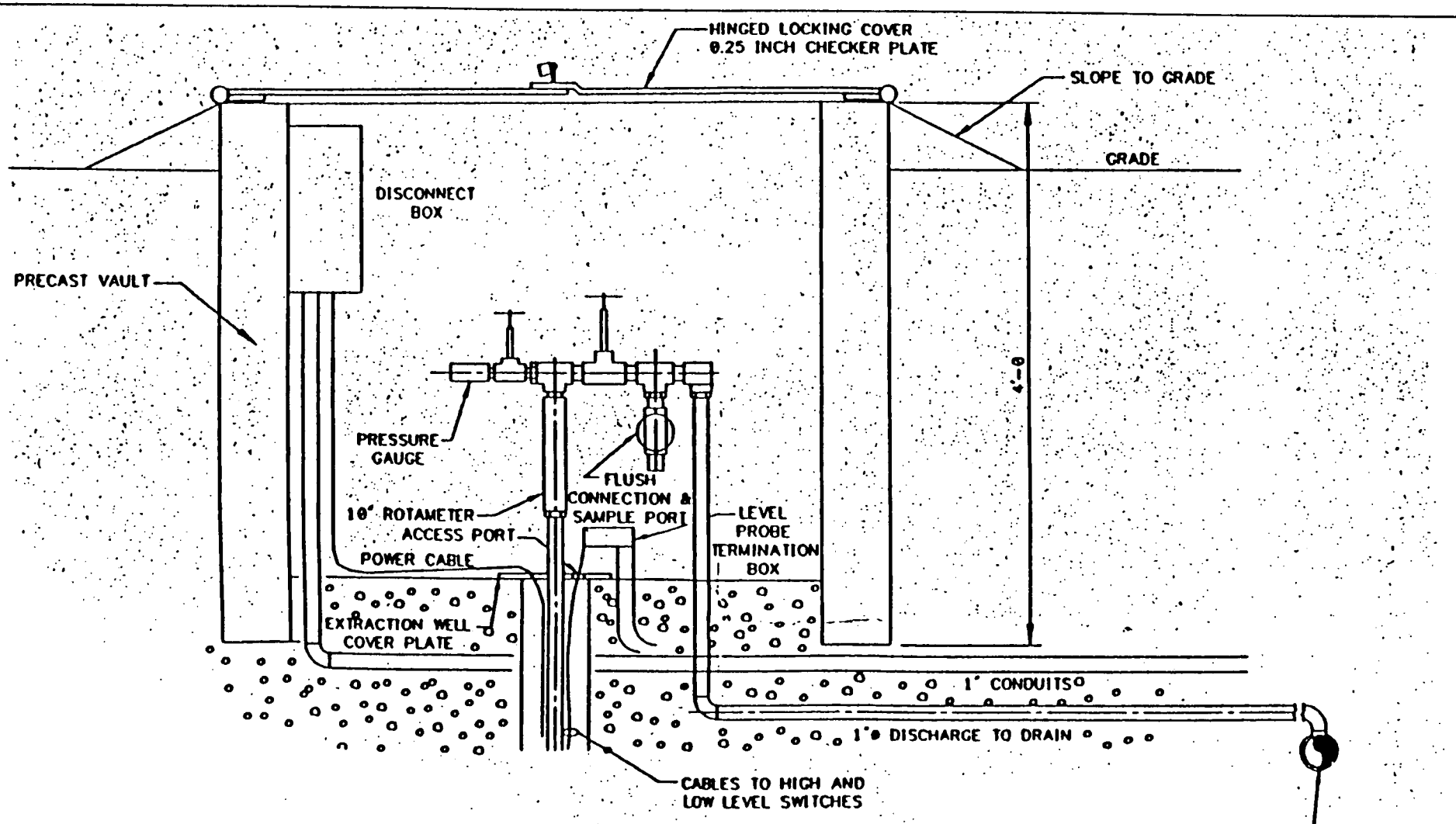

EXTRACTION WELLHEAD VAULT
EW-2 THROUGH EW-8
EW-11 THROUGH EW-14
PLAN & SECTION VIEWS

NOT TO SCALE

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U.S. Navy RAC
NAWC Warminster, PA

Figure 3-13a

Typical Extraction Wellhead Vault

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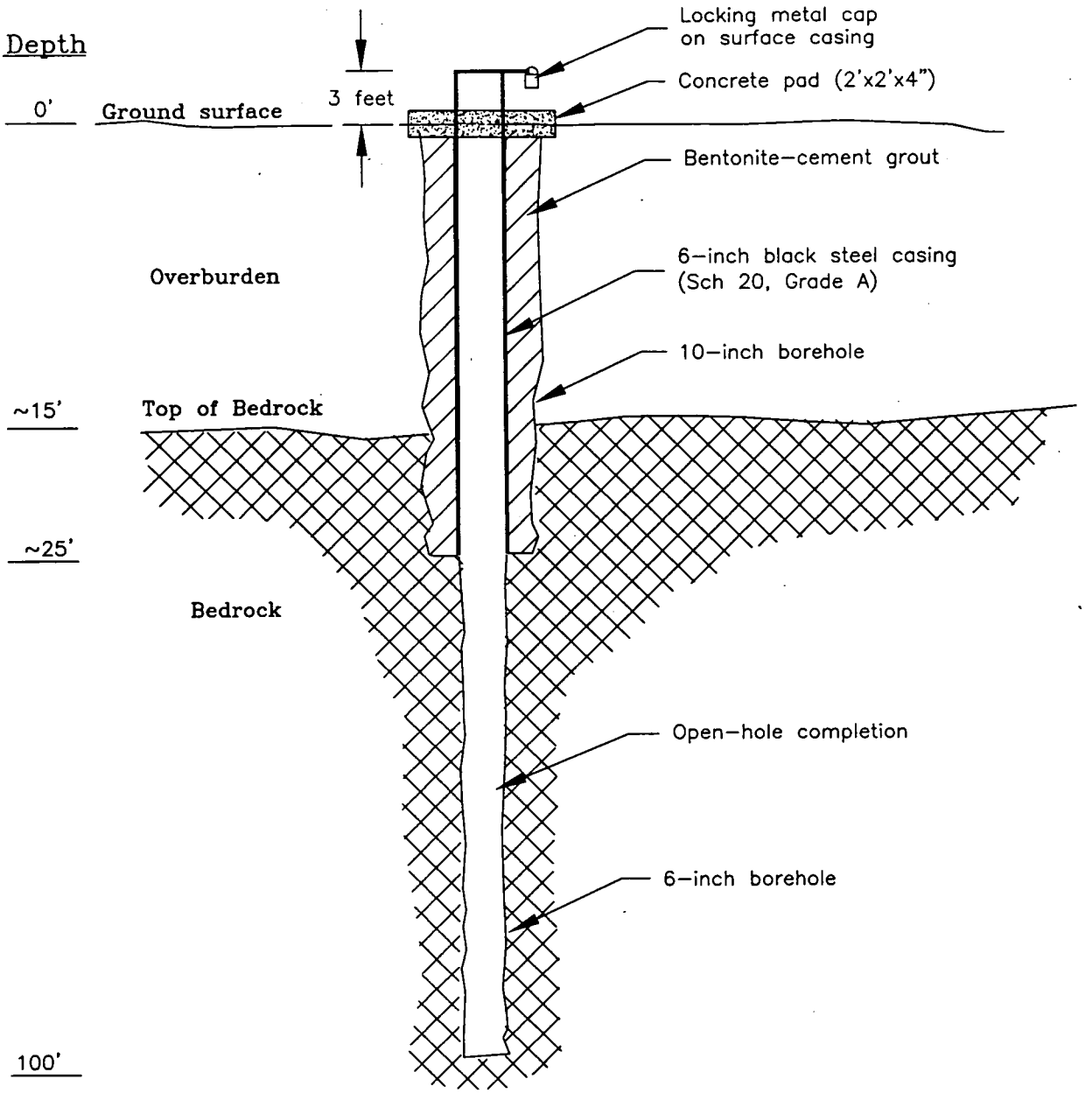

Not to Scale

U. S. Navy RAC
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Figure 3–14

Observation Well Construction Diagram

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Extraction Well Screen Installation

Extraction wells will be completed using 6-inch diameter stainless steel casing and screen. Extraction well screens will consist of stainless steel continuous wound-wire, with a slot size of 0.030 inches. Casing material will be Schedule 5 or better, with screen of compatible strength. Screen and casing connections will be threaded. The EW screens shall extend from approximately five feet below the surface casing to the bottom of the borehole. The screen bottom will be fitted with a stainless steel screw-on plug. Casing and screen will be equipped with a PVC bolt-on centralizer, located midway between the bottom of the well and the bottom of surface casing.

EW casing and screen will be carefully lowered into the borehole and remain suspended in-place until sufficient support is provided by the gravel pack to prevent damage to the screen. The stainless steel inner casing will be cut to fit within the outer surface steel casing, and will be temporarily capped with a PVC slip-on cap. When the screen is in position, the gravel pack will be installed via tremie pipe around the screen, to a height of three feet above the top of the screen. A weighted tape will be used to determine the height of the gravel pack. The weighted tape also serves to tamp down the gravel pack material and prevent bridging. The gravel pack will consist of clean silica sand with a uniformity coefficient of 2.5, and at least a 90% retention for the 0.030-slot screen (Morie #1 or equivalent).

A bentonite pellet seal (at least two feet thick) will be placed atop the gravel pack and allowed to hydrate for at least 4 hours. Following hydration of the bentonite seal, the remaining annulus will be tremie grouted to approximately four feet below grade. The grout will consist of Type I Portland cement, with three pounds of granular bentonite per 94-pound bag of cement, mixed with 6.5 gallons of water.

Observation Wells

Observation wells (OWs) will be drilled ten feet into competent bedrock with a 10-inch air hammer. Six-inch diameter surface casing (Schedule 20, Grade A black steel pipe) will be installed into bedrock in each observation well. The surface casing annulus will be tremie grouted to ground level. The grout will consist of Type I Portland cement, with three pounds of granular bentonite per 94-pound bag of cement, mixed with 6.5 gallons of water.

After installation of the surface casing, open hole drilling may proceed for the first 4 hours after the surface grout has been applied, or after the grout has had a minimum of 24 hours to cure. Observation well drilling will proceed to total depth using a 6-inch diameter hammer. OWs will be completed as open hole wells (no screen or riser pipe). Each OW will have a 2-foot square, by 4-inch thick, concrete pad installed at ground surface around the well casing. The surface pad will be sloped away from the well, to allow rain water to drain away from the wellhead. OW boreholes will be developed as described above for EWs.

3.6.2.4 Final Well Development for Screened Extraction Wells

Following a minimum 72-hour grout curing period, each EW will be developed until discharge water is visibly free of fines, or for a maximum of four hours per well. Development will be accomplished using either a submersible pump or via air lift. If air lift development is performed, an inductor pipe will be used with an inner air line to ensure air does not contact the well screen. . Development yield will be controlled to ensure drawdown does not exceed one-third of the maximum available drawdown. Development fluids will be pumped to an on-site holding tank and treated in the existing groundwater treatment system. The Project Hydrogeologist will record development methods, duration, fluid characteristics, and flow rates in the site logbook.

3.6.2.5 Groundwater Sampling via Packer Assembly

The drilling subcontractor will supply packer sampling equipment, including an inflatable packer, submersible pump, packer inflation air supply/lines/piping, and any other associated equipment required to perform packer sampling. Packer sampling will be used to collect groundwater samples from fractures near the bottom of the well borings, as directed by the Project Hydrogeologist. The packer assembly will allow groundwater samples to be collected from newly encountered deep fractures, without dilution from potentially less-contaminated fractures up hole.

The need to obtain a groundwater sample during drilling will be a field decision based on observation of estimated yield and field screening of VOCs as drilling proceeds to total depth (TD). If any increased flame ionization detector (FID) level is observed below the first water-bearing zone(s), the VOC concentration produced from that particular fracture will be estimated, taking into consideration dilution from water produced by upper fractures. If the estimated VOC concentration from the zone in question approaches action levels detailed in Section 3.6.2.6, drilling will cease, and the packer assembly will be used to obtain an isolated groundwater sample. Groundwater samples will be analyzed in the field using a portable gas chromatograph (GC), calibrated to PCE and TCE standards.

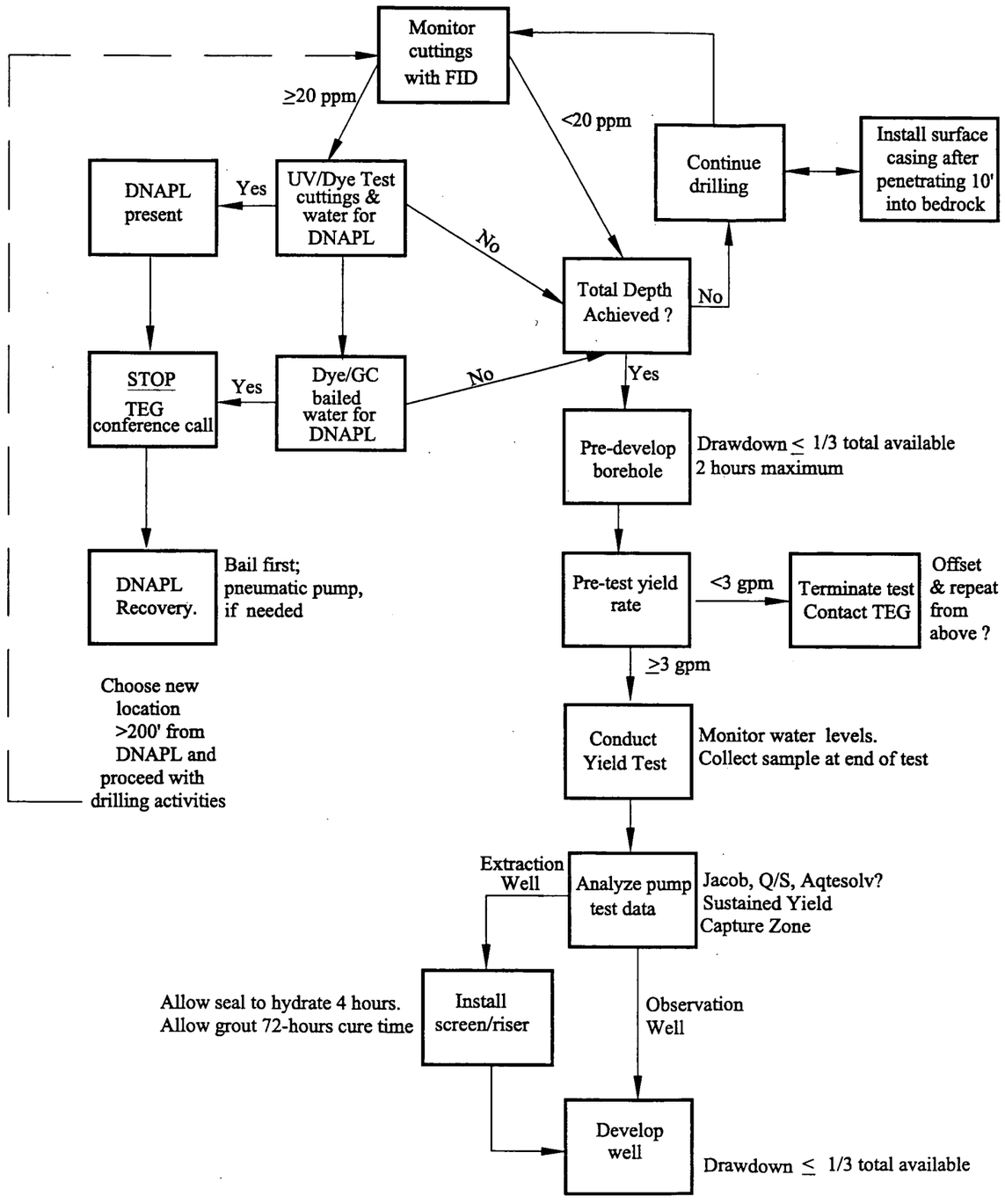
3.6.2.6 Monitoring During Drilling/Installation of Wells

In conjunction with drilling activities and well installation at Area A, several nearby and downgradient monitoring wells will be monitored on a daily basis for water level fluctuations, presence of DNAPLs, and dissolved-phase PCE and TCE content. Figures 3-15 and 3-16 illustrate the various testing activities to be completed during well installation.

Monitoring Requirements for Well Being Drilled

An FID will be used to continuously monitor air, water, and drill cuttings discharged from the borehole during drilling. The Project Hydrogeologist will record FID readings and times for every five feet of drilling penetration. The FID will be calibrated daily, according to the manufacturer's specifications. Calibration records will be maintained in the site H&S logbook. If an FID reading of 20 ppm or greater is detected in the drilling discharge stream, drilling will be halted, the drill bit will be removed from the boring, and the drill cuttings will be tested for the presence of DNAPLs (described below). If DNAPLs are confirmed, drilling will be suspended, and a TEG conference call will be arranged to determine the next course of action.

Testing/Installation Procedures for Area A Extraction & Observation Wells



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U. S. Navy RAC
NAWC Warminster, PA

Figure 3–15

Testing/Installation Procedures for Area A Extraction & Observation Wells

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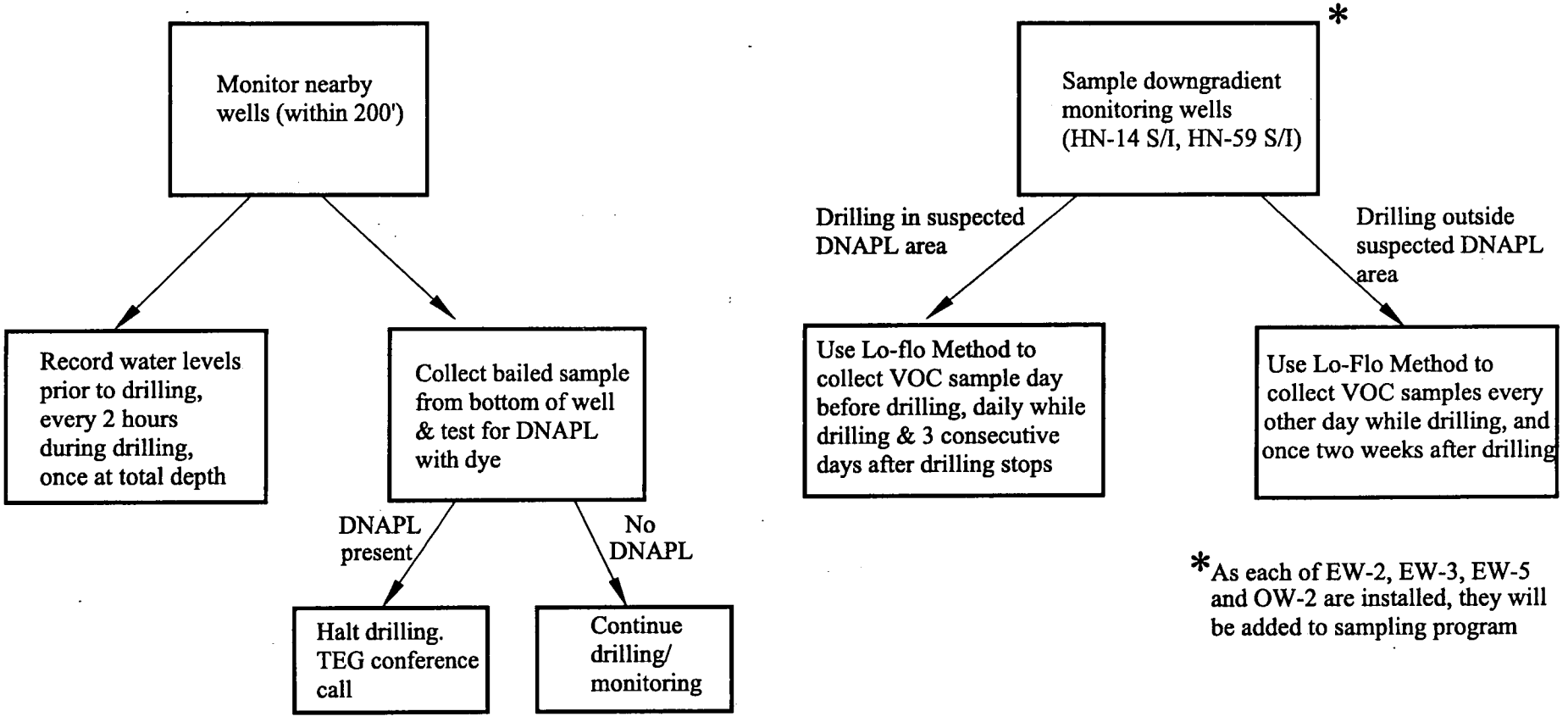
Nearby Monitoring/Sampling During Installation of Area A Extraction/Observation Wells



*As each of EW-2, EW-3, EW-5 and OW-2 are installed, they will be added to sampling program

U. S. Navy RAC
NAWC Warminster, PA

Figure 3–16
Nearby Monitoring /Sampling During Installation for Area A Extraction & Observation Wells

FOSTER WHEELER ENVIRONMENTAL CORPORATION

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The presence of DNAPLs on drill cuttings will be evaluated by scanning cuttings with a wide spectrum, portable, UV lamp (black light), and by dye testing. Procedures for UV scanning are as follows:

1. Collect a sample of drill cuttings/water from the borehole discharge using a bucket.
2. Place the cuttings/water into a clear ZipLoc-type plastic bag.
3. View the bagged sample using a UV lamp in a dark room, or black box equipped with a UV lamp. Adding a small amount of clean (distilled) water can enhance the ability to detect DNAPL fluorescence.
4. Observation of a milky-white fluorescence, other than calcite, will be considered indicative of DNAPL presence.

Drilling water and cuttings will also be analyzed for the presence of emulsified DNAPLs, using "Oil-Red-O" hydrophobic dye. A small aliquot of dye will be added to the bagged sample, and the sample will be shaken for approximately 20 seconds. The presence of DNAPLs will be confirmed visually by any red color in the DNAPL fraction (the dye is insoluble in water). Dye testing is typically very effective for identifying the presence of DNAPLs at saturations greater than 2%.

If drilling has been halted at a point below the water table, a water sample will be obtained from the bottom of the borehole using a disposable, transparent, double-check valve bailer. The water sample will be analyzed as follows:

1. If DNAPL is observed in the bailed sample, an interface probe will be used to measure DNAPL thickness at the bottom of the borehole. Drilling will be suspended, pending a TEG conference call to determine the next course of action.
2. If DNAPL is not observed in the bailed sample, a portion of the sample from the top of the bailer will be placed in a 40 ml VOA vial and kept cool (4°C) pending subsequent field GC analysis.
3. A sample will then be taken from the bottom of the bailer for testing via hydrophobic dye. If dye testing confirms the presence of DNAPL, drilling will be suspended, pending a TEG conference call to determine the next course of action.
4. If DNAPLs are not confirmed via direct observation or dye testing, the VOA sample will be analyzed using the field GC. If the GC results detect PCE in excess of 3 ppm, or TCE in excess of 23 ppm, drilling will be suspended, pending a TEG conference call to determine the next course of action. If the field GC results are less than these action levels, drilling will resume.

The Field Chemist will set up, calibrate, and operate the field GC, recording all calibration and analytical results in a field logbook. The GC will be calibrated using PCE and TCE standards.

Monitoring of Nearby Wells

All wells within 200 feet of a well being drilled will be monitored daily for the presence of DNAPLs. A double-check valve bailer will be used to obtain a water sample from the bottom of each well. A sample will be taken from the bottom of the bailer and tested for DNAPL using the hydrophobic dye method described above. If dye testing confirms the presence of DNAPL, drilling activities will be suspended, pending a TEG conference call to determine the next course of action.

Water levels in all wells located within 200 feet of the well being drilled will be measured once immediately prior to starting drilling; at 2 hour intervals during, and after drilling is completed. The Project Hydrogeologist will be responsible for obtaining the water level measurements using an electric water level indicator. Water depths, relative to the top of a surveyed mark on the inner casing, will be recorded for each measurement to the nearest 0.01 inches.

Monitoring of Downgradient Monitoring Wells

The following downgradient wells will be sampled throughout the duration of Area A drilling: HN-11S, HN11I, HN-14S, HN-14I, HN-59S, and HN-59I. If TCE concentrations in well cluster HN-16I/D are higher than the concentrations in HN-14S/I, then HN-16S and HN-16I will be added to the monitoring list. Water samples from these wells will be obtained via dedicated sample pumps, in accordance with low-flow groundwater sampling procedures. Groundwater sample will be preserved in 40 ml VOA vials, placed in iced coolers, and analyzed via field GC.

While drilling in suspected DNAPL source areas (EW-2, EW-3, EW-4, EW-5, and OW-2), groundwater samples will be obtained from the above-listed wells the day before drilling is initiated; daily while drilling is underway; daily for three consecutive days after drilling has stopped; and, three times per week (Monday, Wednesday, Friday) for two weeks after drilling has ceased. In addition, as each of wells EW-2, EW-3, EW-4, EW-5, and OW-2 are installed, they will be added to this sampling program.

Groundwater sampling from downgradient wells during drilling outside suspected DNAPL source areas will be performed every other day during drilling, and once, two weeks after drilling has ceased.

These samples will be field analyzed (via GC) on the same day they are obtained, and the results will be faxed to the TEG within 24 hours of collection. Cumulative sample results will be presented graphically for each well (sampling) location.

3.6.2.7 DNAPL Recovery

If the presence of DNAPL is confirmed in a well, or bailed groundwater exhibits PCE or TCE concentrations above 3 ppm or 23 ppm respectively, drilling will be suspended and DNAPL recovery efforts will be initiated. Initial DNAPL recovery will rely on bailing from the bottom of the borehole and evaluating DNAPL response. If bailing fails to reduce or eliminate the DNAPL from the bottom of the borehole, a bottom-loading pneumatic pump may be employed to increase the DNAPL recovery rate. All water produced during DNAPL recovery will be treated prior to discharge, in accordance with parameters established in the PADEP temporary discharge permit. Exact field procedures for DNAPL recovery will be decided by the TEG, if necessary.

Drilling of wells located more than 200 feet from a well undergoing DNAPL recovery may proceed, at the TEG's discretion.

3.6.2.8 Yield Tests

The extraction well network is designed to intercept and prevent contaminated groundwater from migrating downgradient (northwest) and off-site. Well spacing will be designed (based on yield tests) to ensure a continuous capture zone is created by the extraction well network. Yield tests (6-8 hour duration) will be conducted for each EW to measure the hydraulic characteristics and estimate the radius of influence produced by each EW. In addition, final pump selection for each EW will be based on the specific capacity of each well, and the required combined pumping effects for the extraction well network.

Yield Test Schedule

Yield tests will be conducted in each EW, immediately after completing preliminary development procedures to clean out the borehole, to aid in determining the next EW location. Analysis of yield test

results will be conducted in the field, so the well placement decisions for the next well to be drilled can be made by the TEG expeditiously. Every effort will be made to reduce or eliminate drilling standby time associated with the well placement decision process.

Yield Test Assumptions

Based on the Halliburton/NUS April 1994 Design Analysis Report, the following hydrogeologic conditions are assumed, unless test results indicate otherwise:

1. the overburden and bedrock are hydraulically connected;
2. the relatively high frequency of bedrock fractures will result in a pumping response similar to a porous medium (i.e., similar to an unconsolidated, unconfined or semi-confined aquifer); and,
3. the aquifer is of infinite areal extent and uniform thickness.

Yield Test Setup Requirements

The drilling subcontractor will supply all equipment necessary to conduct the yield tests (including generator to power the downhole pump). A submersible pump capable of delivering approximately 20 gallons per minute (GPM) at 200 psi will be required. The pump will be positioned within five (5) feet of the bottom of the well. Discharge fittings must be secure and leak proof. Test pump discharge piping will include, in order of placement from the pump site: a flow adjustment valve, a flow meter (turbine type with totalizer), and a sample port. To ensure measuring accuracy, the discharge pipe will include an appropriate length of straight, blank pipe before and after the metering devices. Discharge piping will be routed to the on-site holding tank prior to treatment in the existing groundwater treatment system. Precautions must be taken to ensure the discharge line is not disturbed by vehicular traffic (which could affect the discharge rate).

An FID will be used to monitor the discharge water quality during each yield test. The FID will be properly calibrated prior to each test, with the calibration and monitoring results recorded in the field logbook.

The test pump and discharge lines must be decontaminated by flushing with five gallons of fresh water prior to inserting into each well.

Water Level Measurement Equipment

Foster Wheeler Environmental will supply all electronic water level measuring devices (Solinst Model 101 or equivalent). Water levels will be measured at each well relative to a clearly marked, surveyed point at the top of the inner casing. The horizontal location and vertical elevations of all newly-installed wells will be surveyed by a licensed professional surveyor following completion of wellheads and associated piping.

Automatic water level data loggers using pressure transducers (TELOG 2100, In Situ SE 2000 or equivalent) will be used to monitor/record water levels in the pumping well and the six nearest wells located within 300 feet of the pumping well. The transducers will be placed 50 feet below static water level in the pumping well (25 psi transducer) and 20 feet below static water level in the other wells (10 psi transducer). The transducers will be placed in each well at least one hour before pumping is started to allow them to adjust thermally. Each transducer must be secured to the inner well casing (duct tape is generally sufficient), to prevent movement during the test. Pressure transducers and cable will be decontaminated using an Alconox and fresh water rinse, prior to inserting the equipment into each well.

All field personnel involved in the pump tests will use synchronized watches, enabling data recording to the nearest second. Water level measurements will be recorded for each individual observation well on "Yield Test Data Forms" (Figure 3-17). Water level readings will be recorded in the field logbook, and copied onto the appropriate form after the test(s). Times shall be recorded to the nearest minute, except during the first hour when they will be recorded to the nearest second.

Pre-Test Measurements

The test pump should be installed and tested at least 12 hours prior to start of the yield test. The generator and pump shall be operated to confirm performance and adjust the discharge valve to six (6) gpm, or an alternate rate established by the field hydrogeologist based on preliminary yield estimates obtained during borehole development. Discharge rate shall be controlled by valving, not by using a variable-speed submersible pump. Equipment/pump testing shall be conducted the day before the yield test, with pumping time not to exceed 5 minutes. All testing parameters shall be recorded in the field logbook.

Total available drawdown is defined as the distance from the bottom of the well to static water level. The design pumping level is considered to be one-third of the total available drawdown. These levels will be determined prior to the start of the yield test(s) (during borehole development).

Static water levels will be measured by hand (using electronic water level indicators) in all wells located within 500 feet of the pumping well. These measurements will be made at least once the day before the yield test, and twice before pumping has begun. Any significant variations in water levels will be noted, and if appropriate, investigated (i.e., barometric effects, nearby pumping, surface discharges, etc.). A potentiometric map of Area A will be prepared by hand prior to the start of each yield test, and the horizontal hydraulic gradient and orientation will be determined.

The automated data loggers (TELOG or equivalent) will be installed with recorders programmed to record data logarithmically, with final data recorded at 5 minute intervals. Depth to water (DTW) via hand measurements and data logger readout will be recorded for comparison, and any differences will be noted for subsequent correction.

The yield test may begin after all equipment is in place, recorders are properly setup, and pre-pumping measurements have been completed.

FIGURE 3 - 17

YIELD TEST DATA FORM
N.A.W.C. WARMINSTER, PA

YIELD TEST PUMPING WELL: __________

OBSERVATION WELL: __________ Elevation to TOC: ________

DATE	ACTUAL TIME	ELAPSED TIME	DEPTH TO WATER (ft)	WATER ELEVATION (ft)	COMMENTS

Starting a Yield Test

Personnel for each yield test will include two hydrogeologists and one operator from the drilling subcontractor to operate the pump and maintain the generator. When the pump operator starts the pump, one hydrogeologist will hand gauge the pumping well, while the other (starts the data logger and) monitors the discharge flow rate. The discharge flow rate will be monitored every 5 minutes for the first 30 minutes of the pump test, at 10 minute intervals for the first hour, and at least once/hour for the remainder of the pump test. Flow rates will be adjusted, as needed, to maintain a constant rate. All measurements, adjustments, and times will be recorded in the field logbook.

Water level in the pumping well will be hand-measured every 30 seconds for the first 5 minutes of the pump test; at 1 minute intervals from 5-10 minutes; at 2 minute intervals from 10-30 minutes; every 5 minutes from 30-60 minutes; and, at 30 minute intervals for the remainder of the test.

Water levels in the three wells nearest to the pumping well will be hand-measured at least four times during the first hour of the test, and hourly thereafter. All other wells within 500 feet of the pumping well will be hand-measured at least four times during the test.

If initial pumping indicates the well is not capable of sustaining a rate of at least 3 gpm with less than two-thirds of available drawdown, the test will be terminated. If the drawdown in the pumping well exceeds 50% of the available drawdown during the first 2 hours of the test, the rate will be reduced to try to achieve a stable drawdown level. Pumping rates in the test well will be adjusted to prevent the pumping level from going below two-thirds of the available drawdown at any time during the test.

If the well is capable of yielding a much higher rate, the test shall be run at the design rate until the water level has stabilized (less than 0.15 feet of change/hour) for at least two hours. Any increase in pumping rate will be made at 3 gpm increments, with a minimum of one hour stabilization between rate increases. Any rate adjustments made due to pumping level considerations will require rate and level measurements at the frequency specified for the start of the test (provided above).

Water Quality Testing

The discharge water quality will be field tested at least once every 2 hours, using an FID headspace reading. Water quality screening procedures are as follows:

1. Collect a water sample from a sampling tap on the discharge line and place it into a wide-mouthed, one-half liter glass jar.
2. Fill the glass jar to the halfway point and seal the jar with an aluminum foil cover and rubber band.
3. After allowing the sample to equilibrate for one minute, pierce the aluminum foil with the FID sampling probe to obtain a headspace reading. Record the peak FID reading and time.

Discharge samples will be collected for laboratory analysis (Section 5) immediately prior to terminating the yield test. Laboratory samples will be collected from the discharge sampling port, and placed into two labeled and preserved (HCl) 40 ml VOA vials. The sample vials will be placed in an iced cooler and shipped to the laboratory for analysis via EPA Method 601. Forty-eight (48) hour turnaround time is required for laboratory results.

Yield Test Recovery Data

If the drawdown or flow rate data obtained during the initial portion of the yield test is questionable,

water level recovery data will be obtained when the pump is shut off (measure rising head). Recovery data at the pumping well and the three nearest observation wells with appreciable pumping influence will be recorded for a minimum of one hour, using the FID frequency intervals specified for the start of the test.

Yield Test Data Analysis

The yield test data will be analyzed manually, and/or via computer program (such as AQTESOLV), in the field as the test proceeds. Semi-logarithmic plots of time verses drawdown and distance verses drawdown will be prepared for the pumping well and the nearest wells that show appreciable pumping influence. Data for graph preparation will include both hand-measured water level data and corrected data logger readings, as needed.

The Cooper-Jacob (1946) straight-line method will be used to determine transmissivity (T) and storage coefficient (S) using the distance-drawdown and time-drawdown plots. Specific capacity (Q/s) at the end of the test will also be used to determine T using Walton's (1962) method. If AQTESOLV is used, the data will also be analyzed using the Neuman (1975) and Theis (1935) methods. If recovery data is used, T will be estimated using Driscoll's (1986) method. Greatest emphasis will be given to the determination of T using distance-drawdown data, since this data provides averages over the greatest area of the aquifer, and can best account for axial variations.

The relevant equations for the Cooper-Jacob Method using time-drawdown data are as follows:

$$T = \frac{264Q}{\Delta s}$$

where, T = Transmissivity (gpm/ft)
Q = pumping rate (gpm)
Δs = change in drawdown over one log cycle (feet)

$$S = \frac{0.3\,Tt_0}{r^2}$$

S = Storage Coefficient (dimensionless)
T = Transmissivity (gpm/ft)
t_0 = intercept of straight line at zero drawdown (days)
r = distance (feet) from the pumped well to the observation well

The relevant equations for the Cooper-Jacob Method using distance-drawdown data are as follows:

$$T = \frac{528Q}{\Delta s}$$

where, T = Transmissivity (gpm/ft)
Q = pumping rate (gpm)
Δs = change in drawdown over one log cycle (feet)

$$S = \frac{0.3\,Tt}{r_0^2}$$

S = Storage Coefficient (dimensionless)
T = Transmissivity (gpm/ft)
t = time since pumping started (days)
r_0 = intercept of extended straight line at zero drawdown (feet)

All aquifer test methods specified above are described in detail in Groundwater and Wells (Driscoll, 1986) and Analysis and Evaluation of Pumping Test Data (Kruseman and deRidder, 1990).

Sustainable yield will be estimated using a semi-log plot of time-drawdown projected over a three month pumping period. The design pumping level (30% of available drawdown) will be used as the desired drawdown after 90 days. The slope from this graphic analysis will be applied to the Cooper-Jacob time/drawdown method to determine the pumping rate (Q). This method will provide a conservative estimate of the long-term, single pumping well, sustainable yield.

A capture zone analysis (Keely and Tsang, 1983) will be performed for each EW using calculated T values, estimated sustainable yield, and the local hydraulic gradient (determined from pre-pumping potentiometric maps). Based on a conservative use of the single well capture zone results, and the results from adjacent well pumping, appropriate well spacing can be determined for subsequent "step-out" extraction wells.

Water quality results from the FID field analyses will be reviewed with the objective of insuring that the EW with the highest readings will be the most vigorously pumped when the entire extraction well network is completed.

Yield Test Decisions

The field-derived yield test analyses and recommended locations for "step-out" extraction wells will be presented to the Navy Technical Representative by 0900 hours, the morning after the yield test. Based on the results of these tests, the Navy will authorize (or modify) the next well location. This decision process must be expedited to minimize/avoid subcontractor standby costs and project delays.

It is anticipated that all wells will be drilled to a depth of approximately 80 feet bgs. However, if variations in well yield and/or water quality at different pumping levels indicate adjustments are needed, recommendations will be discussed with the TEG.

Yield Test Reports

A preliminary yield test report will be submitted to the TEG during the meeting following each yield test. The report will include (at a minimum) copies of distance-drawdown and time-drawdown graphs, transmissivity calculations, sustainable yield calculations, capture zone calculations, and recommended location(s) for the next extraction well.

A final yield test report will be submitted to the TEG within two weeks of each yield test. The final report will include (at a minimum):

1. a description of all field procedures;
2. pumping rates and durations;
3. drawdowns in the pumping and observation wells;
4. field water quality data;
5. laboratory water quality analyses;
6. yield test plots and calculations;
7. estimated sustainable yield and capture zone analyses;
8. water level data from hand-measurements and printouts from automated data loggers.

Within two weeks of completing all yield tests at Area A, the TEG will submit a report to the Navy summarizing yield test results for all Area A extraction wells. The report will include recommended pumping rates for each extraction well, along with pump specifications.

3.6.3 Groundwater Transfer Piping Installation

Following the drilling of each well, the area surrounding the well will be excavated to the required elevation to allow for the installation of the pre-cast concrete well vaults. Prior to the installation of the vaults, Foster Wheeler Environmental will excavate the necessary trenches for the drainage pipe and electrical conduit for each well. The lines will be installed and stubbed up to each well location. The concrete vault and piping can then be set in place and backfilled, and the well drilling subcontractor will

then be required to install the groundwater pumps within the wells. At this time, the conduit stub-ups will be run to the junction boxes to be installed within each concrete vault (Figure 3-13a).

The Area A transfer sump, which was previously installed during the construction of the groundwater pump and treat plant and the Area C extraction system, is not located in the position specified on the design drawings (specifically drawings C-3 and C-5). In the design, the transfer sump was located between extraction wells EW-5 and EW-6, to allow for gravity flow from each of the nine well heads to the transfer sump. This location is shown as a low point in the designed pipe routing. Instead, the Area A transfer sump will be positioned in a location approximately mid-way between extraction wells EW-1 and EW-2 shown on the drawings C-3 and C-5.

As part of the surveying work to be performed, Foster Wheeler Environmental will determine if the inlet to the existing Area A transfer sump is located at a depth that will allow gravity flow from the nine new well heads. If gravity flow is not possible from all or some of the new well heads, a modification to the design drawings will need to be made. This modification will most likely be comprised of resizing the groundwater well pumps and piping from the affected extraction wells, to be a force main-type system to the Area A transfer sump, rather than gravity flow.

If surveying indicates that gravity flow is possible from all nine of the new extraction wells, Foster Wheeler Environmental will proceed with the original concept/design of pumping the groundwater out of the wells and then allowing it to flow via gravity to the Area A transfer sump, where it will be pumped to the groundwater pump and treat system. Minor modifications will still be required to the design drawings, due to the as-built location of the Area A transfer sump. The piping from each extraction well will be 4 inch diameter, single-wall High Density Polyethylene (HDPE), as indicated in the design documents. The design for the Area A transfer system does not call for double-walled piping or leak detection as in the design for Area C. The gravity flow piping from the extraction wells will be installed at a minimum depth of 42" below grade.

Upon completion of the 4 inch HDPE gravity flow piping from each extraction well to the Area A transfer sump, the groundwater transfer piping excavation will begin. This excavation will continue from the Area A transfer station to the groundwater pump and treat plant. The trench excavation will be uniform with existing grade, and the groundwater transfer piping and conduit will be installed in this trench. The trench will be excavated to the proper elevation along the approved survey route. Upon achieving the proper elevation, pipe bedding material will be placed within the trench and compacted to the specified density. Foster Wheeler Environmental will perform leak testing of all piping systems, as specified in the design documents.

The joining process for the HDPE piping will involve fusion welding with the proper equipment as recommended by the pipe manufacturer. Foster Wheeler Environmental's Project Superintendent will ensure that the personnel installing the HDPE pipe are properly trained in the use of the fusion welding equipment. When the pipe is placed in the trench, the integrity of the weld will be tested as required by the project specifications; and upon successful testing, the pipe will be backfilled with the excavated material to the specified elevation, and compacted with a plate compactor.

All electrical and signal wiring/conduit will then be installed within the trench. The conduit will then be backfilled to the specified elevation, and warning tape added over the conduit runs prior to final backfilling and compaction to the original grade.

3.6.4 Control System (CMCS) Modification/Startup

The existing CMCS for the groundwater pump and treat plant has been installed anticipating the construction of the Area A extraction wells. As such, Foster Wheeler Environmental will obtain the

services of the control system vendor to assist with the final connections, and startup of the Area A extraction wells and transfer sump system. As part of the initial investigation, the control system vendor will be brought on-site to inspect the CMCS and determine what, if any, additional work needs to be performed for the operation of the Area A collection and transfer system.

3.6.5 Restoration

After the construction activities are completed in Area A, restoration will include placement of certified topsoil, final grading and seeding. The equipment operators will grade and level the area with equipment that has been previously decontaminated. Final grading of the upper six inches of topsoil will blend in with existing contours on the site. After completing final grading, all areas where vegetation was disturbed during the construction will be seeded with a commercially available lawn seed mix.

4.0 WASTE REMOVAL PLAN

This section addresses the handling of the various waste streams that will be generated from on-site remedial activities. These materials may include both non-hazardous and hazardous waste. Foster Wheeler Environmental will coordinate all disposal activities with the designated NAWC Warminster facility Transportation and Disposal Coordinator (T&D Coordinator). The designated Navy representative will be required to sign all bills, manifests, land ban forms or other forms or paperwork required by regulations and the disposal facility.

4.1 WASTE ANALYSIS/CLASSIFICATION

4.1.1 Site 4 (See original Work Plan)

4.1.2 Site 6 (See Work Plan Addendum No. 1)

4.1.3 UST Farm (See Work Plan Addendum No. 2)

4.1.4 Sites 1,2, and 3 (See Work Plan Addendum No. 3)

4.1.5 Area A Extraction Wells

Drill cuttings generated as part of the well installation will be containerized in a designated roll-off. Foster Wheeler Environmental will submit composite samples for PADEP Form U laboratory analyses to classify the material for disposal purposes.

Non-hazardous debris will include, in addition to the drill cuttings, office and support zone trash and PPE. Proper handling and storage requirements will be maintained during the extent of the project.

If hazardous or TSCA wastes are found on site, other treatment technologies may be required.

As part of the drilling and well installation, an unknown quantity of water will be generated requiring disposal. The water will be stored in an on-site tank and subsequently treated in the existing groundwater treatment system.

As part of the equipment decontamination, an unknown volume of water will be generated which will require disposal. The decon water will be stored as non-hazardous and tested for constituents of concern, if hazardous wastes are encountered during the remediation. Storage of decon water will most likely be in drums; however, if larger quantities of water are generated, a poly tank will be utilized.

4.2 DOCUMENTATION (See original Work Plan)

4.3 TRANSPORTATION (See original Work Plan)

4.4 DISPOSAL (See original Work Plan)

5.0 FIELD SAMPLING AND ANALYSIS PLAN

The remedial actions to be performed at the NAWC Warminster facility require field sampling and analysis data for the disposal decision making process. Post-excavation, confirmatory sampling will be performed by other Navy contractors and will not be addressed in this section. The types of sampling per site are described below.

Two types of sampling will be performed as part of the Area A remediation; Pre-Mobilization and Perimeter Air Monitoring. Pre-Mobilization samples include waste characterization sampling of the hot spot areas. Perimeter Air Monitoring will include air samples collected from the perimeter of the site to survey for off-site dust migration.

5.1 SAMPLING PROCEDURES

5.1.1 Sampling Objectives

5.1.1.1 Site 4 (See original Work Plan)

5.1.1.2 Site 6 (See Work Plan Addendum No. 1)

5.1.1.3 UST Farm (See Work Plan Addendum No. 2)

5.1.1.4 Sites 1, 2, and 3 (from Work Plan Addendum No. 3)

Data generated by implementation of the field sampling and analysis plan will be used for the following purposes:

- To characterize waste streams for off-site disposal; and
- To monitor the site boundary for air emissions from the remedial activities.

Table 5-4 presents the analytical testing requirements, as well as the analytical methodology, bottleware and allowable holding times for the sample analysis. The actual locations of the samples will be marked on a drawing and a description of the sample material and location will be submitted to the Navy with the analytical results. Personnel air monitoring, equipment, personnel decontamination and other health and safety related issues are discussed in the HASP.

Pre-Mobilization Sample Strategy

_____ soil boring samples will be collected and analyzed for full PADEP Form U parameters. Each boring location will be spaced to represent approximately 200 cubic yards of material. One composite sample will be collected for each boring. Additional samples may be required if any of the soil is characterized as being hazardous.

Perimeter Air Monitoring Sample Strategy

Engineering controls will mitigate fugitive dust emissions during excavation activities. The air-sampling program is designed to obtain periodic confirmation air samples to monitor off-site dust migration from remediation activities. Total Suspended Particulates (TSP) and metals will be selected as indicator contaminants. Samples will be collected two times per week for the duration of the hot spot excavation activities at four locations, with collocated samplers at one location. The location of the samplers will be determined in the field. Field blanks will be collected at a rate of one per every ten samples.

TSP sampling will be conducted using AIRMETRICS MiniVol Portable Survey Samplers. These

samplers are portable, battery operated, and can be suspended from a bracket mounted on a variety of structures (final mounting determination will be made in the field). Ambient air is pumped through a 47-mm filter at a rate of 5 liters per minute. At the end of each sampling period, the filter assembly and battery pack are removed and replaced for the next sampling period. Sampling periods will be 24-hours in duration. The air samples will be analyzed for gravimetric weight (TSP) and the presence of pre-determined target metals.

Air sampling results will be validated, reduced, and tabulated. Results will be evaluated to determine the magnitude of site perimeter air contamination. All data will be reported in the Closeout Report.

5.1.1.5 Area A Extraction Wells

As part of the installation of Area A extraction wells water quality will be monitored in extraction wells installed and nearby monitoring wells. The majority of this water quality monitoring will utilize field measurements and has been described in Section 3.6 of this Work Plan Addendum No. 4. However, at the end of each yield test performed on newly installed extraction wells, a discharge sample will be collected for fixed laboratory analysis. Laboratory samples will be collected from the discharge sampling port, and placed into two labeled and preserved (HCl) 40 ml VOA vials. The sample vials will be placed in an iced cooler and shipped to the laboratory for analysis via EPA Method 601. Forty-eight (48) hour turnaround time is required for laboratory results. Table 5-4 presents the analytical testing requirements, as well as the analytical methodology, bottleware and allowable holding times for the sample analysis. The actual locations of the samples will be marked on a site map, and a description of the sample material and location will be submitted to the Navy with the analytical results.

5.1.2 Sample Turnaround Time (See original Work Plan)

5.1.3 Sample Tracking System (See original Work Plan)

5.2 CHEMICAL QUALITY ASSURANCE/QUALITY CONTROL

All quality assurance/quality control (QA/QC) requirements will be consistent with those described in the NAVY INSTALLATION RESTORATION LABORATORY QUALITY ASSURANCE GUIDE: Interim Guidance Document, NFESC, February 1996.

In order to meet the data quality objectives, Foster Wheeler Environmental and its contracted laboratory will utilize a reduced deliverable data package equivalent to the Navy's Level C data package. Data validation will not be performed unless requested by the Navy.

TABLE 5-4
NAVAL AIR WARFARE CENTER
WARMINSTER, PA (DO #0018)
SITES, 1,2, AND 3
SAMPLE COLLECTION AND ANALYTICAL PROTOCOL INFORMATION

Location/ Objective	Sample Type/ Matrix	Sample Quantity	Parameters	Sample Container	Sample Preservative	Analytical Method	Method Detection Limit	Holding Times
Sites 1, 2, & 3 - Profile Samples	Waste Characteri-zation (soils) PADEP Form U Table A Analysis	TBD	TCLP Volatile Organics (VOAs)	(1) 8 oz. glass jar	Cool to 4°C	Extract as per zero headspace extraction in Method 1311. Analyze as per Method 8240B (SW 846)	Compound-specific (0.2-100 mg/L)	14 days extract 14 days analyze
			TCLP Semi-volatiles (SVOAs)	(1) 8 oz. glass jar	Cool to 4°C	TCLP extraction as per Method 1311. Analyze as per Method 8270B (SW 846) **	Compound-specific (0.008-400 mg/L)	14 days extract 7 days analyze
			TCLP Metals Analysis, plus copper, nickel and zinc	(1) 8 oz. glass jar	Cool to 4°C	TCLP extraction as per Method 1311. Analyze as per Method 7000 Series (SW-846)	Analyte-specific (0.2-100 mg/L)	6 months ; 28 days for Hg
			TCLP Pesticides	(1) 8 oz glass jar	Cool to 4°C	TCLP extraction as per Method 1311. Analyze as per Method 8080 (SW-846)	Compound-specific (0.008-10.0 mg/L)	7 days to extraction 40 days to analysis
			TCLP Herbicides	(1) 8 oz glass jar	Cool to 4°C	TCLP extraction as per Method 1311. Analyze as per Method 8150 (SW-846)	Analyte-specific (1.0-100 mg/L)	7 days to extraction 40 days to analysis
			PCB	(1) 8 oz. glass jar	Cool to 4°C	Method 8080 (SW846)	Compound-specific (33-67 ug/kg)	7 days extract 40 days analyze
			pH	(1) 4 oz. glass jar		Method 9040,9045 (SW846)	—	Analyze immediately

TABLE 5-4
NAVAL AIR WARFARE CENTER
WARMINSTER, PA (DO #0018)
SITES, 1,2, AND 3
SAMPLE COLLECTION AND ANALYTICAL PROTOCOL INFORMATION
(Page 2 of 4)

Location/ Objective	Sample Type/ Matrix	Sample Quantity	Parameters	Sample Container	Sample Preservative	Analytical Method	Method Detection Limit	Holding Times
			Ignitability	(1) 4 oz. glass jar		Method 1010 (SW 846)	—	7 days
			Reactivity	(1) 4 oz. glass jar	Cool to 4°C	Method 7.3.3.2,7.3.3.4 (SW846)	—	7 days
			Oil and Grease	(1) 8 oz. glass jar w/Teflon-lined cap	Cool to 4°C	Method 418.1	10 ug/kg 30,000 ug/kg haz waste	7 days extract 7 days analyze
			Paint filter test	(1) 4 oz. glass jar	Cool to 4°C	Method 9095	—	
			Total Solids	(1) 4 oz glass jar	Cool to 4°C	Method 160.3 (SW-846)	—	7 days
			Total Volatile Solids	(1) 4 oz glass jar	Cool to 4°C	Method 160.4 (SW-846)	—	7 days
			Chemical Oxygen Demand	(1) 4- oz glass jar	Cool to 4°C	ASTM water leachate extraction as per Method D3957. Analyze as per Method 410.4 (EPA 600)	3 mg/L	—
			Total Solids	(1) 4 oz glass jar	Cool to 4°C	ASTM water leachate extraction as per Method D3957. Analyze as per Method 160.3 (SW-846)	—	7 days
			Oil and Grease	(1) 4 oz glass jar	Cool to 4°C	ASTM water leachate extraction as per Method D3957. Analyze as per Method 413.1 (EPA 600)	5 ug/L	7 days

TABLE 5-4
NAVAL AIR WARFARE CENTER
WARMINSTER, PA (DO #0018)
SITES, 1,2, AND 3
SAMPLE COLLECTION AND ANALYTICAL PROTOCOL INFORMATION
(Page 3 of 4)

Location/ Objective	Sample Type/ Matrix	Sample Quantity	Parameters	Sample Container	Sample Preservative	Analytical Method	Method Detection Limit	Holding Times
			Ammonia-N	(1) 4-oz glass jar	Cool to 4°C	ASTM water leachate extraction as per Method D3957. Analyze as per Method 305.2 (EPA 600)	—	28 days
Sites 1, 2, & 3 - Surface/ Decontamination Water	Waste Characteri-zation (water)	TBD	TCL Volatile Organics (VOAs)	(3) 40 mL amber VOA vial	Cool to 4°C; pH < 2 w/ HCl	Analyze as per Method 624*	Compound-specific (5-10 ug/L)	14 days extract 14 days analyze
			TCL Semi-Volatile Organics	(2) 1 L amber glass jar	Cool to 4°C	Method 625*	Compound-specific (0.05-25 ug/L)	5 days extract; 40 days analyze
			TAL Metals Analysis	(1) 1 L plastic jar	Cool to 4°C; pH > 2 w/ HNO_3	Analyze as per Method 200 Series*	Analyte-specific (0.2-5000 ug/L)	6 months; 28 days for Hg
			PCBs	(2) 1 L amber glass jar	Cool to 4°C	Method 608*	Compound-specific (1-2 ug/L)	7 days extract 40 days analyze
			pH	(1) 500 mL plastic jar		Method 150*	—	Analyze immediately
			TSS/TDS	(1) 500 mL plastic jar	Cool to 4°C	Methods 160.2/160.1*	—	7 days
Sites 1, 2, & 3 - Perimeter Air Samples	Dust	TBD	Chromium Lead	(1) 47 mm fiber/quartz filter	N/A	Method 7300 (NIOSH)	0.1 ug 2.0 ug	N/A
			Total Suspended Particulate (TSP) Analysis	(1) 47 mm fiber/quartz filter		Modified 7191 (NIOSH)	240 ug	N/A
Air Samples (Blank)	Dust	TBD	Total Suspended Particulate (TSP) Analysis	(1) 47 mm fiber/quartz filter		Modified 7191 (NIOSH)	240 ug	N/A
			Metals TBD	(1) 47 mm fiber/quartz filter	N/A	Method 7300 (NIOSH)	0.1 ug 2.0 ug	N/A

TABLE 5-4
NAVAL AIR WARFARE CENTER
WARMINSTER, PA (DO #0018)
SITES, 1,2, AND 3
SAMPLE COLLECTION AND ANALYTICAL PROTOCOL INFORMATION
(Page 4 of 4)

Location/ Objective	Sample Type/ Matrix	Sample Quantity	Parameters	Sample Container	Sample Preservative	Analytical Method	Method Detection Limit	Holding Times
AREA A EW & OWs	Groundwater	12	Purgeable Halocarbons	(2) 40 ml amber VOA vials	Cool to 4°C pH < 2 w/ HCl	Method 601	Compound Specific (1-5 ug/l)	14 days to extract 14 days to analyze

Notes:

1. QC/QA samples are not required for the waste characterization sampling.
2. The number in parentheses in the "sample container column" denotes the number of containers needed.
3. Method abbreviations:
   SW-846 - Test Methods for Evaluating Solid Waste, OSWER, November 1986, revised January 1995.
4. Detection limits for soil samples may vary due to percent moisture. The limits listed for soil are based on wet weight.
5. All holding times listed are from Verified Time of Sample Receipt (VTSR) by the laboratory unless noted otherwise.
6. * = All analytical performed in accordance of EPA Water/Waste Water Methods, 600/4-79-020, 3/83.
7. ** = After TCLP extraction, pH will be obtained by Method 9040, 9045 (SW-846).
8. ~ = not applicable or non available.
9. N/A = Not Applicable.

5.2.1 QA/QC Samples (See original Work Plan)

5.2.2 Sample Shipping and Packaging (See original Work Plan)

5.2.3 Laboratory Data Reporting (See original Work Plan)

5.2.4 Records (See original Work Plan)

6.0 HEALTH AND SAFETY REQUIREMENTS

Addendum #5 to the original Site-Specific Health and Safety Plan (SHSP), dated May 13, 1996 will be prepared and submitted to the Navy Environmental Health Center under separate cover.

7.0 ENVIRONMENTAL PROTECTION AND REGULATORY COMPLIANCE

Activities associated with the completion of this project will be conducted in accordance with the requirements identified in Part 4.0, Environmental Requirements, of the RAC, as well as the requirements in the Foster Wheeler Environmental Regulatory Compliance Policies and Procedures.

No environmental permits will be required for these cleanup activities. However, compliance with applicable Federal and State environmental and construction regulations will be followed. Discussion of applicable regulations and standards follows.

7.1 AIR POLLUTION CONTROL (See original Work Plan)

7.2 STORM WATER AND EROSION CONTROL

This section contains information about remedial activities that will require erosion and sedimentation control. Descriptions of all remediation activities can be found in Section 3.0 of this addendum.

7.2.1 Introduction (See Original Work Plan)

7.2.2 Site 4 (See Original Work Plan)

7.2.3 Site 6 (See Work Plan Addendum No. 1)

7.2.4 Ust Farm (See Work Plan Addendum No. 2)

7.2.5 Sites 1, 2, and 3 (from Work Plan Addendum No. 4)

Site Preparation

The first task associated with site preparation is the installation of a silt fence in the areas indicated on Figure 3-12. The silt fence will be installed as shown on Figure 7-1 of the original Work Plan.
Silt fence will be utilized as a temporary erosion and sediment pollution control around the project. Silt fence

will also be placed as necessary to accommodate site conditions at the direction of the Project Superintendent and/or Senior Project Engineer/Manager. The silt fence will be inspected and maintained throughout the course of the project.

Hay bales will be placed around nearby storm water inlets to prevent solids deposition in the system.

Soil Berms will be constructed to prevent surface runoff from entering excavations on an as needed basis

Excavation and Load-Out

Dust control measures consisting of water spray will be implemented as necessary during excavation and other activities that generate dust.

Soil will be directly loaded from the excavations onto the trucks to minimize handling and cross contamination.

Hauling Activities

All waste disposal trucks will utilize the stabilized construction roads consisting of 6 inches of compacted gravel.

Site Restoration

Upon completion of remedial tasks, the site will be restored to its original conditions. Disturbed areas will be re-vegetated as necessary to establish pre-construction conditions.

Silt fence will be installed on the up gradient side of the re-seeded areas to prevent channeling or erosion.

Removal of the silt fence will be the final task associated with restoration activities and will only be done after vegetative cover has been established.

7.2.6 Area A Groundwater Extraction and Transfer System

Site Preparation

The first task associated with the site preparation is to perform any repairs necessary to the existing silt fencing and installation of additional silt fencing (as deemed necessary) in the areas indicated on Figure 3-12A. It is anticipated that silt fencing installed during the Site(s) 1, 2 and 3 remediation will be in place at the time of the start of the work of this addendum. All silt fence will be installed as shown on Figure 7-1 of the original Work Plan.

Silt fence will be utilized as a temporary erosion and sediment pollution control around the project. Silt fence will also be placed as necessary to accommodate site conditions at the direction of the Project Superintendent and/or Senior Project Engineer/Manager. The silt fence will be inspected and maintained throughout the course of the project.

Hay bales will be place around nearby storm water inlets to prevent solids deposition in the system. Soil berms will be constructed to prevent surface runoff from entering excavations on an as needed basis.

Excavation and Load-Out

Dust control measures consisting of water spray will be implemented as necessary during excavation and other activities that may generate dust.

Any soils or drill cuttings which are to be disposed of off-site will be directly loaded from excavations (trenches, well vaults, etc.) onto either trucks or 55-gallon drums to minimize handling of contamination.

Site Restoration

Upon completion of construction activities, the site will be restored to its original condition. Disturbed areas will be re-vegetated as necessary to establish pre-construction conditions.

Silt fence will installed on the up gradient side of re-seeded areas to prevent channeling or erosion. Removal of silt fence will be the final task associated with the restoration activities and will only be done after vegetative cover has been established.

7.3 WASTE MANAGEMENT (See original Work Plan)

7.4 TRANSPORTATION (See original Work Plan)

7.5 DISPOSAL (See original Work Plan)

7.6 EMERGENCY RESPONSE AND SPILL CONTROL (See original Work Plan)

8.0 PROJECT MANAGEMENT

8.1 PROJECT SCHEDULE

8.1.1 Site 4 (See original Work Plan)

8.1.2 Site 6 (See Work Plan Addendum No. 1)

8.1.3 UST Farm (See Work Plan Addendum No. 2)

8.1.4 Sites 1, 2, and 3 (See Work Plan Addendum No. 3)

8.1.5 Area A Groundwater Extraction and Transfer System

Figure 8-7 depicts the preliminary project schedule. Foster Wheeler Environmental intends to mobilize for the well installation task in conjunction with the completion of the Sites 1, 2 and 3 excavation and backfilling tasks.

8.2 PROJECT STAFFING PLAN

8.2.1 Site 4 (See original Work Plan)

8.2.2 (See Work Plan Addendum No. 1)

8.2.3 UST Farm (See Work Plan Addendum No. 2)

8.2.4 Sites 1, 2, and 3 (See Work Plan Addendum No. 3)

8.2.5 Area A Groundwater Extraction and Transfer System

Figure 8-8 depicts the project organization chart. This chart has been organized to depict technical and administrative functions as well as lines of communication and reporting for the project. Personnel will include the Project Superintendent, Project Hydrogeologist, Project Engineer and the Senior Project Engineer/Manager. The Project Superintendent will be responsible for the field operations to be performed by Foster Wheeler Environmental and any subcontractor's. The Project Superintendent will oversee all field labor, the use of equipment, and the availability and use of all necessary material and tools. The Project Superintendent will be initially mobilized to the site to become familiar with the nature and goals of the project by examining the project plans and specifications, and discussions with Foster Wheeler technical personnel and the Navy.

The Project Hydrogeologist will be responsible for overseeing the installation of all extraction and observation wells, and ensuring that these tasks are being performed in accordance with project drawings, specifications, and the drilling plans. The Project Hydrogeologist will interact with the Project Superintendent, The BRE Hydrogeologist and Project Engineer to schedule drilling and sampling activities, and to solve any technical problems which may arise during the installation of the wells. In addition, the Project Hydrogeologist will be responsible for overseeing the drilling subcontractor's activities, and to act as a liaison with the Navy's and TEG Committee's hydrogeologists during

installation of the wells.

The Project Engineer will be responsible for overseeing the field operations and ensuring that project tasks are being performed in accordance with the project drawings and specifications. The Project Engineer will interact with the Project Superintendent in scheduling activities, material deliveries, and to resolve any technical problems which may arise during the course of the project. The Project Engineer will be responsible for the coordination of the review of all project submittals, and maintenance of the submittal register. The Project Engineer will also be responsible for overseeing the subcontract activities to be performed on site, and to act as a liaison with all Navy representatives assigned to the project.

The Senior Project Engineer/Manager will be responsible for the overall performance of the project team, including keeping the project on schedule and within budget. The Senior Project Engineer/Manager will provide guidance to the Project Superintendent, Project Hydrogeologist and Project Engineer to keep the project progressing. All invoices to be paid during the course of the project shall be reviewed and approved by the Senior Project Engineer/Manager.

The on-site project staff will also include a Site Health and Safety Officer. Craft staffing will be determined just prior to mobilization.

8.2.6 Project Superintendent (See original Work Plan)

8.2.7 Site Health and Safety Officer (See original Work Plan)

8.2.8 Quality Control Manager (See original Work Plan)

8.3 MEETINGS (See original Work Plan)

9.0 CIVIL QUALITY ASSURANCE/QUALITY CONTROL

A separate Civil Quality Control Plan (QC Plan) was submitted for D. O. #0018 on June 21, 1996.

Early Start	Early Finish	Percent Complete	Activity
JOB E018			
AREA A EXTRACTION WELLS			
26JAN98A	23FEB98A	100	PREPARE DRAFT PRE-CONSTRUCTION SUBMITTALS
23FEB98A		100	SUBMIT DRAFT PRE-CONSTRUCTION SUBMITTALS
23FEB98A	20MAR98A	100	NAVY REVIEW OF PRE-CONSTRUCTION SUBMITTALS
21JUL98A	25SEP98A	100	DRILLER PROCUREMENT
	29SEP98	0	SUBMIT FINAL PRE-CONSTRUCTION SUBMITTALS
05OCT98	27NOV98	0	WELL INSTALLATION/TESTING, ETC.
30NOV98	22JAN99	0	GROUNDWATER TRANSFER SYSTEM INSTALLATION
25JAN99	29JAN99	0	CONTROL SYSTEM MODIFICATION/CHECKOUT
01FEB99	16FEB99	0	STARTUP/TESTING
02FEB99	22FEB99	0	POST-CONSTRUCTION SURVEY
23FEB99	25FEB99	0	SITE RESTORATION
26FEB99	29MAR99	0	POST-CONSTRUCTION REPORT/AS-BUILT PREPARATION

1998: JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

1999: JAN FEB MAR APR MAY JUN JUL AUG SEP

Project Start	05APR96
Project Finish	03NOV99
Data Date	25SEP98
Run Date	29SEP98

Early Bar
Target Early Bar
Progress Bar
Critical Activity

1800

Sheet 1 of 1

NAWC WARMINSTER, PA

D.O. 0018

Date	Revision	Checked	Approved

Figure 8-8
NAWC Warminster, PA
Project Organization Chart